Compressed Air

A MONTHLY MAGAZINE DEVOTED TO THE USEFUL APPLICATIONS OF COMPRESSED AIR.

VOL. X. NEW YORK, OCTOBER, 1905. No. 8.

"Compressed Air,"

OR

THE COMPRESSED AIR MAGAZINE.

A MONTHLY PUBLICATION DEVOTED TO THE USEFUL APPLICATIONS OF COMPRESSED AIR.

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Subscription, including postage, United States, Canada and Mexico, $1.00 a year. All other counries, $1.50 a year. Single copies, 10 cents.

Advertising rates furnished on application.

We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

All communications should be addressed to COMPRESSED AIR, 11 Broadway, New York.

London Office, 114 Queen Victoria Street.

Those who fail to receive papers promptly will please notify us at once.

Entered as Second-Class Matter at the New York, N. Y., Post Office.

VOL. X. OCTOBER, 1905. NO. 8

The Theory of the Air-Lift.

Of the varied uses of compressed air which have fully demonstrated their value to the industrial world, the so-called air-lift is of special interest. Despite its recognized practicability it is a mystery to the vast majority of the engineering profession and utterly unknown to many who might use it to advantage.

Even among those who have given the subject careful study there is a difference of opinion as to its true theory of operation.

The air-lift is generally selected where there is a driven well, in which the water has risen approximately near the surface. In this well is placed a large pipe for the discharge of the water. This is known as the "eduction pipe." This pipe does not touch the bottom of the well, but is elevated above it so as to freely admit the water through its lower end. Alongside of this pipe, either on the outside or within, is a small pipe properly proportioned and intended to convey compressed air to a point near the bottom of the eduction pipe. It is usual to provide what is called a "foot piece," which forms the nozzle connecting the air pipe with the water pipe; but, in what is known as the "central pipe system," this foot piece is not used, the air pipe being placed within the eduction pipe to a point near the bottom, where it discharges the compressed air into the water column.

The air pipe is connected with an air receiver in or near the power house where the air compressor is located. The air pipe is provided with a valve located between the top of the well and the receiver. Before turning on the air, the conditions in the well show the water at the same level inside and outside of the eduction pipe. At the first operation there must be sufficient air pressure to discharge the column of water which stands in the eduction pipe. This goes out *en masse,* after which the pump assumes a normal condition, the air pressure being lowered and standing at such point as corresponds with the normal conditions in the well. This is determined by the volume of water which the well will yield in a certain time and the elevation to which the water is discharged. It is here that so many mistakes are made by the inexperienced, who lack knowledge of the proper proportions to be given to the air and eduction pipes.

It was at first supposed that in the airlift the water was discharged because of the aeration of the water in the eduction pipe, due to the intimate commingling of air and water. Bubbles of air, rising in a water column, have a tendency not only to carry particles of water with the air, but to make the column lighter, and with a submergence or weight of water on the outside of the eduction pipe, there would naturally be a constant discharge of air and water. This is known as the Frizell System, and where the lifts are moderate

—that is, where the water in the well reaches a point near the surface—it is very likely that the discharge is due to simple aeration.

Most air-lift propositions include the lifting of water from wells for a greater distance than 25 feet; and just in proportion as the lift is increased do we get away from the idea of lifting by aeration and reach the Pohle theory of piston-like layers. According to this system the air and water rise in alternate layers. After the first discharge there is kept up a constant struggle between the air under pressure and the head of water on the outside of the pipe, each seeking to enter the lower end of the eduction pipe. When the air pressure is greater than the head of water, a certain volume of compressed air is admitted into the eduction pipe, the water in this pipe is at that time moving rapidly upward, its momentum having been established at the first discharge. Hence the air takes up the velocity and goes upward with the water. If a sufficient quantity of air in proportion to the diameter of the pipe has been admitted and if there is a sufficient pressure in this pipe to prevent the free discharge of the air, it is easy to see how this bubble of air spreads itself out across the diameter of the pipe like a piston. The reason why this air piston is not elongated and continuous when the air is once admitted is that the free discharge of the air, aided by the velocity with which everything in the eduction pipe is moving, causes a fall in the air pressure below that of the head of water, just sufficient to allow the latter to press the water into the air space from the open end of the eduction pipe. In other words, as the air pressure is slightly lowered the water pressure, which was nearly equal to the air pressure, becomes the greater and a piston-like layer of water enters the pipe, shutting off the air. This layer or "chuck" of water rises into the eduction pipe with the same velocity as the air and water before it. As the water has for the moment closed the air nozzle, there is a momentary rest, during which the air has a chance to accumulate greater pressure, and just as soon as its pressure overcomes that of the water the conditions are reversed, and another "chunk" of compressed air is discharged into the pipe, shutting off the water for an instant. This process is continuous and as regular as the movement of a pendulum.

As these "chunks" of air approach the top of the eduction pipe they are gradually enlarged, because of the reduced load upon them, and it is probable that before they reach the surface there is a general breaking up of the piston-like layer conditions.

In order to secure the most economical results from the air-lift, it is essential that the pipes be in proper proportion. To understand this question of proper pipe proportions, take an exaggerated case, where there is a lift say, 100 feet and an eduction pipe 12 feet in diameter. Such a case as this is impracticable, and no matter how much air is discharged into this pipe, it is likely to rise in the shape of bubbles, some of them larger than others, because as they ascend they cohere; but piston-like layers can only be formed in so large a pipe as this where there is a sufficient head or height of discharge and an enormous volume of water. In other words, the volume of water admitted to this pipe of large diameter must be sufficient to keep pace with the large volume of air admitted.

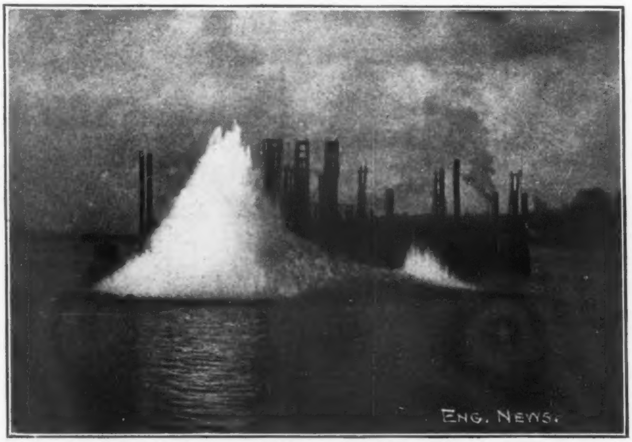
Methods of Subaqueous Rock Excavation, Buffalo Harbor, N. Y.

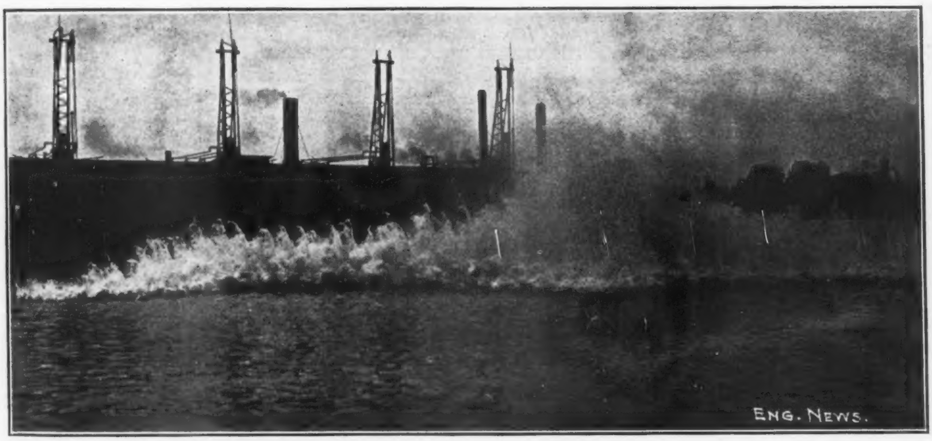
At the present time the United States Government is actively engaged at Buffalo, N. Y., in the formation of a channel 2,300 feet long, 400 feet wide and 23 feet deep at mean lake level, and a branch

channel and basin 1,920 feet long, 500 feet wide and also 23 feet deep at mean lake level.

June 13, 1902, which carried an appropriation of $814,643 for the work.

Appendix Q Q of the Annual Report





SUBMARINE BLASTING FOR ROCK EXCAVATION IN BUFFALO HARBOR.

(A charge of 400 lbs. of dynamite placed in holes drilled in the bottom at a depth of about 20 ft.)

This improvement is known as the Lake Erie Entrance to Black Rock Harbor and Erie Basin, N. Y., and was authorized by the River and Harbor Act of

of the Chief of Engineers, U. S. Army, being the report of the district officers, Theo. A. Bingham, Major, Corps of Engineers (now Brig., U. S. A., retired)

and P. S. Bond, First. Lieut., Corps of Engineers, U. S. A., which has just been published, contains more or less information relative to this work, and has been drawn upon in the preparation of this article, but the greater portion of the matter herein given has been secured from other sources.

The specifications provided for a specified price per cubic yard for the channel work in place, and another specified price per cubic yard for the basin work in place, all without regard to classification of materials.

Bids for the execution of the work were opened January 22, 1903. The proposal of

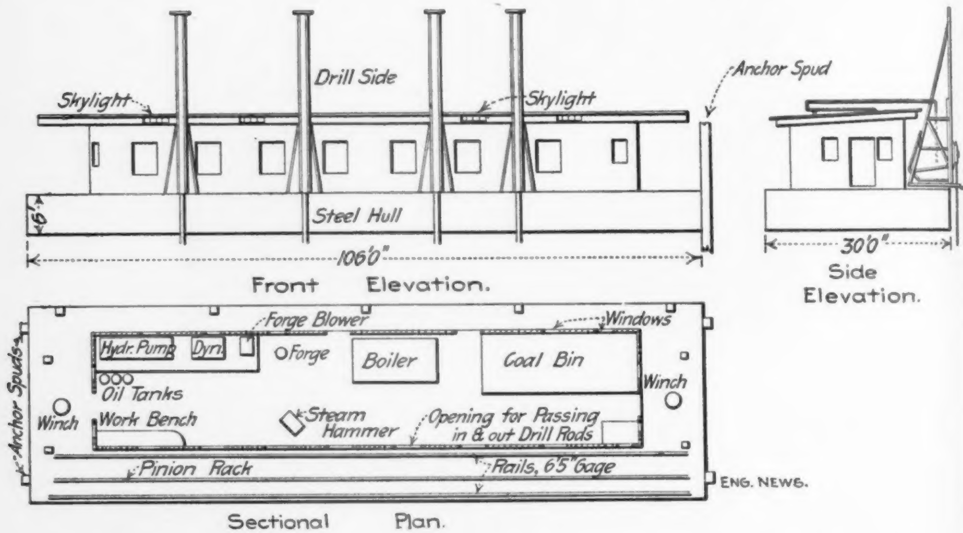


FIG. I. PLAN AND ELEVATIONS OF DRILL BOAT FOR USE IN SUB-AQUEOUS ROCK EXCAVATION, BUFFALO, N. Y.

The plans and specifications for the improvement were drawn up under the direction of Major T. W. Symons, Corps of Engineers, U. S. A.

The area embraced within the branch channel and basin is about 30½ acres and within the channel is about 22 acres.

The estimated amount of material to be excavated from the channel is 300,000 cubic yards, place measure, of which approximately 20 per cent., or 61,000 cubic yards, is rock, and 80 per cent., or 239,000 cubic yards, is earth, mud, clay, etc.

In the basin the total amount of material to be removed is 325,000 cubic yards, place measure, of which approximately 87½ per cent., or 285,000, is rock, and 12½ per cent., or 40,000, is earth, sand, clay, etc.

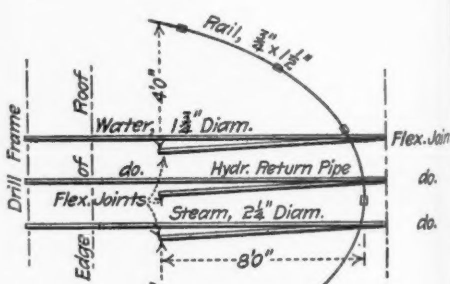


FIG. 2. PLAN OF PIPES ON ROOF, SHOWING FLEXIBILITY TO ALLOW MOVING DRILL.

the Buffalo Dredging Company, of Buffalo, N. Y., was found to be the lowest, and the work was let to them at the following prices:

Excavation of channel, per cubic yard, place measure, $0.66.

Excavation of basin, per cubic yard, place measure, $1.84.

The area drilled over during the season of 1903 comprised 285,000 square feet.

The average depth of rock above the required grade of 23 feet below mean lake level was 2.44 feet, but in order to insure the required depth after blasting and dredging the holes were put down to 25 feet below mean lake level.

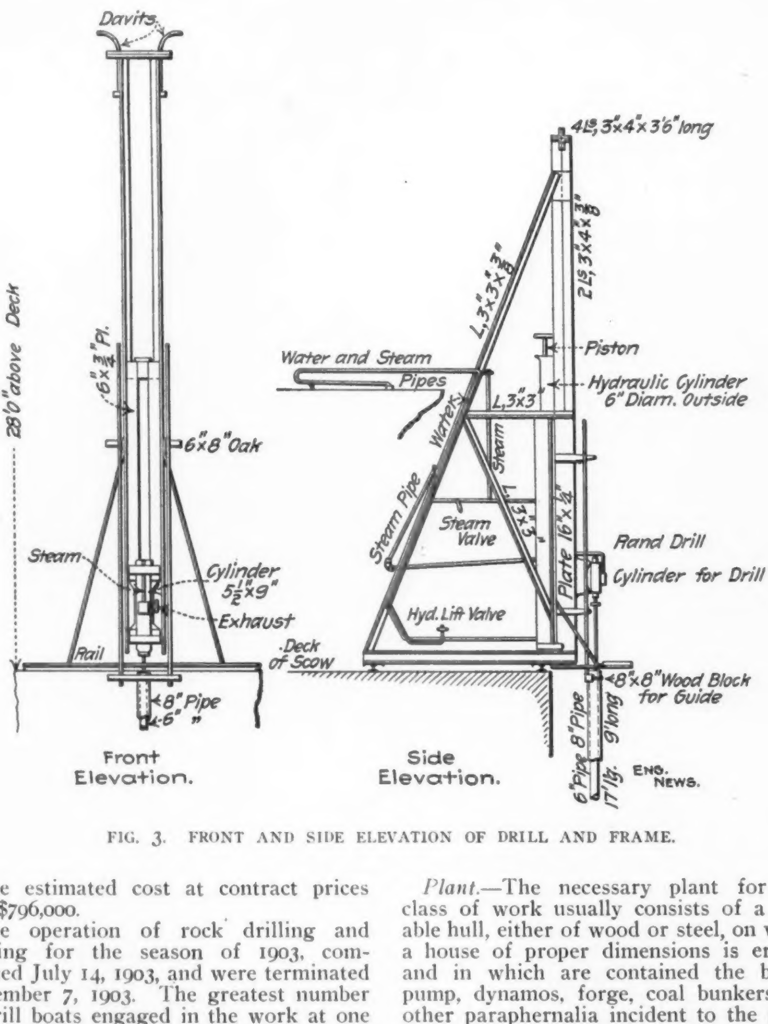


FIG. 3. FRONT AND SIDE ELEVATION OF DRILL AND FRAME.

The estimated cost at contract prices was $796,000.

The operation of rock drilling and blasting for the season of 1903, commenced July 14, 1903, and were terminated November 7, 1903. The greatest number of drill boats engaged in the work at one time was five, but generally four were engaged.

Plant.—The necessary plant for this class of work usually consists of a suitable hull, either of wood or steel, on which a house of proper dimensions is erected and in which are contained the boiler, pump, dynamos, forge, coal bunkers and other paraphernalia incident to the plant, all of which are arranged along one side of the house. Ranged along the opposite

side of the hull are the frames carrying the drills and telescopic pistons worked by hydraulic pressure for raising and lowering the drills, which latter are operated by steam power.

On the earlier drill boats generally but two drills were employed, which were afterward increased to three. Now four drills are commonly used, the hulls being proportionately larger.

drills are raised and lowered. The pistons are worked by water pressure, a pump being used. The drills are operated by steam pressure from a boiler that is 12 feet long and 7 feet in diameter.

The drill frames rest on rails laid on the deck of the hull, and are moved back and forth by a rack and pinion.

The different pipes, supplying water and steam to the pistons and drills, re-

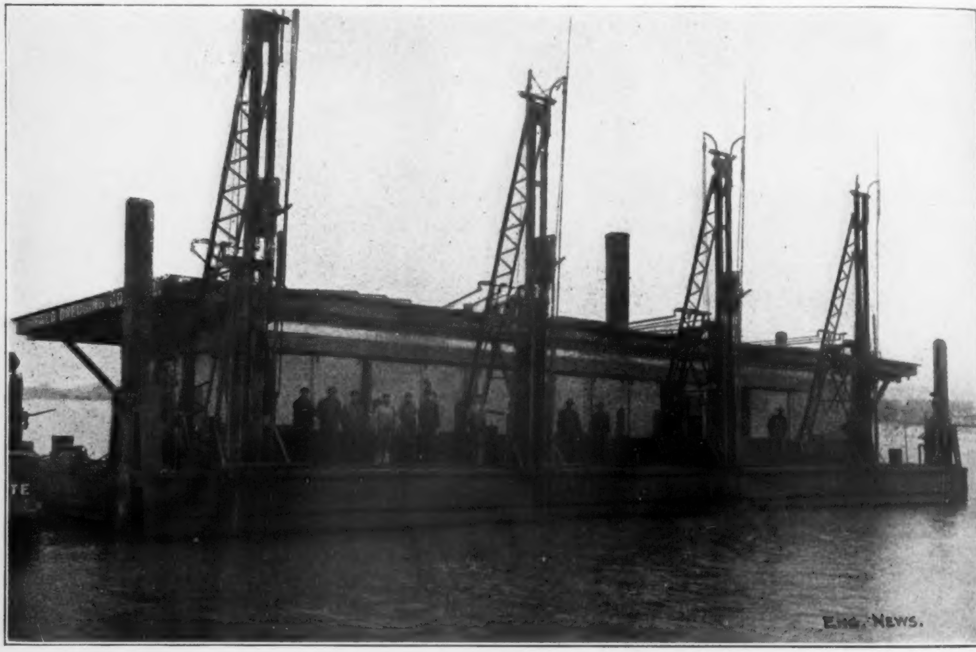


FIG. 4. DRILL BOAT NO. 1, WITH FOUR DRILLS.

Figs. 2, 3 and 4 illustrate a modern type of drill boat, with a hull built of steel.

The hull is 106 feet long, 30 feet wide and 6 feet deep.

On this hull a wooden house is erected. This house measures 86 feet long and 18 feet wide, with a sloping roof 12 feet high on the drill side and 11 feet on the opposite side.

There are four drill frames, each carrying a Rand machine drill, attached to telescopic pistons, by means of which the

spectively, have their joints so arranged as to provide great flexibility, by which they accommodate themselves readily to every change of vertical and horizontal movement.

A supply of drill rods is constantly carried in the drill boat, the X-bits of which are kept in proper order by a blacksmith and two helpers. They are supplied with a forge, supplemented by a hydraulic hammer.

The drill boats are usually operated

FIG. 5. 26½-TON STONE LIFTED BY DREDGE.

FIG. 6. DIPPER AND 26½-TON STONE.

day and night, and in two eleven-hour shifts.

Operating Drill Boats.—In operating the drill boats the boats are first towed to an approximate position by a tug boat, and accurately aligned by means of properly set targets on the shore. They are held in place by the anchor spuds, of which there are four, one in each corner. These are all worked by hydraulic pressure.

In shallow drilling the spacing of the drill holes was generally 4 by 5 feet, equivalent to 0.74 cubic yards, place measurement, per linear foot of drill hole.

A drilled hole was usually shot soon after its completion to the proper grade, the comparative shallow depth of the hole, about 5 feet, and the great depth of water above the same, 20 feet, making the removal of the drill boat unnecessary.

On the completion of a series of holes, about 20, the drill boat was moved onto the next range.

Two months' time was occupied in the dredging and disposition of the drilled and blasted material, which amounted to 37,570 cubic yards, scow measure, or 18,785 cubic yards, estimated place measure, as stated in Appendix Q Q of the Annual Report of the Chief of Engineers, U. S. Army, for 1904.

In this connection it is interesting to show the enormous capacity of the dredge which dredged this rock excavation.

During the dredging operations a slab of limestone was caught lengthwise in the dipper, measuring 3 feet high, 7 feet wide and 15 feet long, weighing 26½ tons, Figs. 5 and 6.

The effect of blasts on the surface of the water is shown in the photographs reproduced. In each case 24 holes containing 400 pounds of 75 per cent. dynamite were fired.—*Engineering News.*

South African Mining.*

In speaking of South African mines in general, it is usual to refer to those in the Johannesburg gold district as typical of the entire country.

In the use of compressed air for mining purposes, the practice in the Witwatersrand represents the highest development of air power to be found in any one mining district. The variety and number of compressor plants in operation is probably unequaled elsewhere.

The diamond mines make little use of compressed air, since the diamond ground is comparatively soft and is drilled by hand jumpers; not even a hammer is needed in the Kimberley mines. The coal mines in Natal have very recently adopted compressed air for coal cutting, but particulars cannot be given here. The Rhodesian gold mines have followed the Johannesburg methods in this as well as other mining matters.

In the Johannesburg district the use of air drills was necessary from the first, as the hard "banket" gold ore cannot be economically developed by hand drilling alone. Owing to the low grade of the ore, the mines can only be successfully worked when large blocks of ground are developed. This condition led to the use of comparatively large compressors from the start, and the usual development through the small semi-portable, or straight-line, compressors did not take place, as is usual in a new mining district.

The early compressors were comparatively small and were extremely inefficient; they were usually of the duplex type; having slide valve steam cylinders, and plain poppet-valve air ends. The discovery of coal within 50 miles of the gold mine made the fuel problem an easy one to solve. It is a curious fact that it was more important to be economical of water than of fuel and for this reason even the earliest plants were run condensing. Coal was close at hand and could be bought, but if the limited water supply failed, operation became impossible. It is no fable that, even after Johannesburg had become a large and important town, water was so scarce that people used bottled soda water for their toilet as well as for diluting their "Scotch."

The present water supply is only sufficient for the existing mines; great additions are in development to provide for the increased demand which will arise in the near future. The result of this condition was the interesting development of the most economical type of compressors, not because of the fuel saving, but because the scarcity of water made condensing engines necessary and the coal economy followed. The present practice aims at both steam and coal economy and compound condensing Corliss engines with two-stage air cylinders are the standard.

* By Fred E. Norton, in *Mines and Minerals*.

The early boiler practice was not in keeping with the engine plants, and many semi-portable boilers were used to drive compound condensing engines. The later practice it to install the most economical boilers regardless of cost; many of them are of the "Lancashire" type so common in English and European plants, but almost unknown in this country.

Considering the expense and difficulty of transportation, it is remarkable that the mining machinery in South Africa developed so quickly into the large and heavy types now in use.

It has always been necessary to run all kinds of machinery up to its maximum capacity, and this has led to the development of high-speed machinery for all purposes. Speaking generally, it may be said that machinery is worked harder in this district than anywhere else in the writer's experience, though the tendency is to slow up a little. Before the recent war it was usual to run every day in the week, and mill engines and compressors were often run for months with only a few hours, once a month, for the necessary packing and adjustment.

It is unusual to see anything very massive or impressive about the machinery plant of a Johannesburg mine. All the engines are strongly built and well proportioned and move with a speed characteristic of the place.

Each mine has a machine shop as well equipped with modern machine tools as a good many manufacturing plants, and generally the engines are kept in splendid order.

The demand for high speed and great capacity naturally led to efforts to increase the output of compressors and the poppet valve of ordinary type was promptly abandoned.

The early machines were not adapted for high speeds and the effort to force them beyond their capacity soon put them in their place on the scrap heap. THE INGERSOLL-SERGEANT Co. were early in the field with their piston-inlet machine; one of the first being shipped direct from the Chicago Exposition to the "Crown Reef" Mine, near Johannesburg, where it did many years of good service. This machine was delivered in the record time of 4½ months from date of order and was followed by many more, so that by 1896 this type was in almost universal use.

The Rand Drill Co. also installed many of their machines, having controlled poppet valves.

The E. P. Allis Co. furnished several large compressors having Corliss air valves; the first being started in 1896.

At this time the typical machine was the cross-compound Corliss condensing engine, having two-stage air cylinders. The steam cylinders were about 20 in. × 38 in. × 48 in. and air cylinders 20 in. × 34 in × 48 in., the machine being rated at 25 ordinary rock drills and delivering 2,500 cubic feet of free air per minute.

The demands for air soon called for compressors of greater capacity and this was met by increasing the size and speed of the compressor.

The Rand mines were the first to move in the direction of higher speeds and introduced the "Riedler" compressor now built by the Allis-Chalmers Co. and Messrs. Fraser & Chalmers, Ltd., of Erith, England. The early compressors of this type passed through several stages of improvement before a thoroughly satisfactory high-speed machine was secured, but they are now running successfully at speeds impossible before the introduction of this type. The automatic-poppet valve seems to be a thing of the past in Johannesburg practice.

The Riedler compressor is so widely advertised that a description seems superfluous.

The Rand mines have installed several of the "King-Riedler" type compressors, having vertical steam cylinders and air cylinders placed tandem, a pair on each side of a crank shaft, to which they are coupled by an inverted triangular connecting-rod. These machines range in capacity from 2,'500 cubic feet to 70,000 cubic feet of free air per minute. They occupy small floor space and have the advantage of vertical cylinders but they are complicated and difficult to maintain or repair.

The largest Riedler compressor in South Africa is at the Simmer & Jack Gold Mine, and is a horizontal compound compressor of the usual type, having a rated capacity of 8,000 cubic feet of free air per minute.

THE INGERSOLL-SERGEANT Co. have recently introduced a controlled poppet valve machine in which high speed is secured by loading the poppet valve by means of pistons, operated by air pressure and controlled by an auxiliary valve. The

auxiliary valve is operated by the piston of the compressor and admits and exhausts air from the controlling pistons in such a way as to help the valve move in the proper direction.

There have been efforts made to avoid the difficulties of operating air valves at high speeds by a radically different means than that employed in the Riedler or Ingersoll-Sergeant compressors.

The German group of mines have adopted a piston-valve compressor, in which the main valve is a single piston; acting both as positive inlet and outlet, while the automatic discharge, to suit varying air pressure, is secured by means of auxiliary poppet valves. The same principle has been applied to Corliss valve machines and a compressor of this type is now being widely advertised in this country. Machines of both piston and Corliss valve construction have been in operation in South Africa for several years and with the best results. The later type of Corliss machine has a separate discharge valve, operated by a differential piston which is compelled to open slightly before the pressure in the cylinder equals the discharge pressure. This has been found advisable in order to avoid the pressure rising higher in the cylinders than the discharge, and the indicator cards show a rounded line of discharge, instead of the "hump" used on compressors in which the valve is opened directly by the cylinder pressure. The elimination of this hump has an important effect on the operation of the compressor, because just at the time the air valve opens to discharge, the piston rod is in a delicately balanced state, since the air and steam pressures are nearly equal. The pounding on the crankpin at the quarters, which is noticeable with many compressors, is entirely absent with the differential discharge valves, while the indicator diagram closely resembles a good steam card.

The durability of either piston or Corliss valves for air cylinders seemed doubtful under the conditions in South Africa on account of the great quantity of dust. The immense tailings heaps of fine sand are blown and do great damage to all kinds of machinery. The successful operation of the machines of both types has proved that the-valves will last as long as the cylinders, which is all that is required.

This dust is the source of endless trouble in the operation of compressors as it accumulates in valve passages, dashpots and in the pipes and receivers of the compressor. Combined with the lubricating oil it forms a dangerous compound in the air receiver, and frequent explosions and "firings" result, unless the best oil and considerable care is used. Soap and water have been tried, but when used alone result in rapid wear of pistons and rods, and it is more usual to alternate oil with the other lubricant. The compressor valves have a considerable effect on the trouble resulting from this cause and valves which are compelled to open widely and permit a free passage of the air seem to prevent much of the danger of explosion; no case has ever occurred of trouble from this source with machines having mechanical valves of good designs. The dust and oil have, in several instances, clogged the automatic valves of the older types of machines so seriously as to result in destructive explosions. The open-inlet type of machine presents great temptation to an ignorant or careless driver to use kerosene oil as a hint to the air-drill men that too much air is being wasted, and in one instance the driver was literally "hoisted with his own petard," as the compressor cylinder was blown to pieces and the driver narrowly escaped serious injury.

The skill and care exercised in the mines in the operation of compressors is generally sufficient to prevent accidents which are in all cases due to neglect or ignorance, if the compressor is of a reasonably good design.

The practice of air compressing has been brought to a high state of efficiency, and leaves little to be desired on the score of economy. Improvements are most to be desired in the direction of simplicity and durability of compressors.

It should be mentioned that the East Rand group of mines adhere to the slow-running "Walker" compressor, which has cast-iron flap valves, hung on a hinge, and cushioned by springs and dashpots. These machines are characteristically English in construction, being heavy all over with little attempt to save weight where it is not needed. They are made amply large for their work and run in a leisurely manner which predicts a long life and high efficiency. They form the exception which proves the rule, that generally the compressors in the Rand are run up to their limit of capacity. I have had the definition of a 25-drill compressor given as

"one that would run 25 drills, three air hoists and five direct-acting pumps." It is only fair to the compressor to say that this is about what they manage to do, and in one instance, investigation of a complaint showed six or eight large forge fires in addition, being blown with air at 80-pounds pressure However, that was several years ago.

The use of compressed air is, unfortunately, not so far advanced as its compression. By far the most important use is the driving of rock drills and any suggestion of economy is hard to find in the modern rock drill. This is not the fault of the designers or builders. There is no machine which does the amount of hard work with such little skill or care in operation as the ordinary drill. In South Africa, the Kaffir operator attends to the drill after it has been set up and started, and frequently he attends to all of that too. The white drill man is boss, but the "boy" usually does the work. The drill goes down and stays until it is worn out or something breaks, when it has a rough trip to the shop. The work is out of sight and impossible of close supervision by the mechanical staff. The drill is a tool and the greatest possible work is got out of it. Any successful attempt at economy in air consumption must not increase the weight of the drill or make it complicated or uncertain in operation.

It is expensive and inconvenient to all concerned to test an improved drill on a large scale, and the prejudices in favor of well-known and tried machines cannot be overcome by experiments with a few drills. Many new drills have been tried but the old standards hold their ground. Each mine man has his own favorite, and is fully persuaded it is the best—the tests always show it is—at least, to his satisfaction. There is great need of a small, light drill to work in narrow stopes; it must be "fool proof" and economical of air; a combination which has not yet been successfully made. The constant effort in Johannesburg has been to get enough cheap labor to supplant the air drill for stoping purposes.

It seems that a portion, at least, of the immense sums spent to secure cheap colored labor might better have been used to develop economical stoping drills, which finally must be the true solution of the eternal labor difficulty which is the curse of South African mines.

Little has been done to aid enthusiasts in this direction.

The policy of the mining industry is open to criticism in their attitude toward inventors. There is a committee of the Chamber of Mines who examine all applications for patents and if they are recognized as possibly useful, the application is opposed by such powerful influence that even if granted, the inventor stands little chance of realizing any substantial amount from its introduction. The fact that among the members of this board are representatives of large commercial concerns, which are apparently heavily subsidized by very powerful mining groups, in a most unjust abuse of the semi-governmental powers of the associated mines, as represented by their Chamber.

The use of compressed air for pumping and hoisting purposes is in little better state than the drill practice. There is no good reason for this, as the conditions are favorable to the use of economical pumps and hoists.

Mr. H. C. Behr recently presented the "Cummings system" of high-pressure transmission in an admirable paper read before the Mechanical Engineers' Association of the Witwatersrand. The system uses air at about 180 pounds pressure in the supply pipe which is returned to the compressor at 90 pounds (both absolute).

The great gain in efficiency is secured by the fact that only two compressions are necessary to get the maximum economy and the temperature of the air does not fall below 40° F., during expansion. A total of efficiency of 60 per cent. has been reached with ordinary direct-acting pumps and it appears that an efficiency well over 70 per cent. would be realized with pumps using the expansion of air. No reheating is required with this system, which promises to come into use at an early date.

There is a single instance of an underground pump with reheater in operation at the Ferrerria Deep Mine which apparently gave good efficiency. The difficulties of underground reheating are so great that extensive use of the system is not to be expected.

The system of using air at ordinary pressure, say 80 pounds gauge pressure, and expanding in triple cylinders with cold water reheaters has not been introduced, but offers so many manifest advantages that it will doubtless be adopted.

Generally electricity has been used for

pumping purposes as the possibilities of economical air pumps have not been given great attention.

The future development of this power will be watched with great interest, as the miners are fully alive to the importance of reduced working costs and are ready and willing to advance beyond the every day practice in any direction, the moment they are convinced that a saving may be made.

As an instance of this progressive policy may be mentioned the ordering of a steam turbine and turbine-compressor set. The state of the art prevented the satisfactory construction of the machine and at last reports the turbine compressor for high pressures is a thing of the future.

The severe competition of machinery builders, the great expense of mining operations by hand labor, together with the liberal policy of most of the mines is sure to lead to a well-balanced and effective scheme for the use, as well as the production, of compressed air. The disturbed conditions following the war have greatly retarded the developments in progress prior to 1899, but the mines are sure to gain new vigor with time and resume the progress in methods which was so suddenly interrupted.

The Ajax Armored Pneumatic Blasting Car.

The Ajax Armored Pneumatic Blasting Car, as shown in the accompanying illustration, is designed for receiving the rock from the blasting in tunnel work. Under the present system, when blasting a round of holes, sometimes steel plates are placed upon the bottom of the tunnel, and sometimes planks are used for this purpose, to facilitate shoveling of this rock into cars for removal. This car is intended to be placed up against the breast for the purpose of receiving the rock as it is thrown out by the blasts.

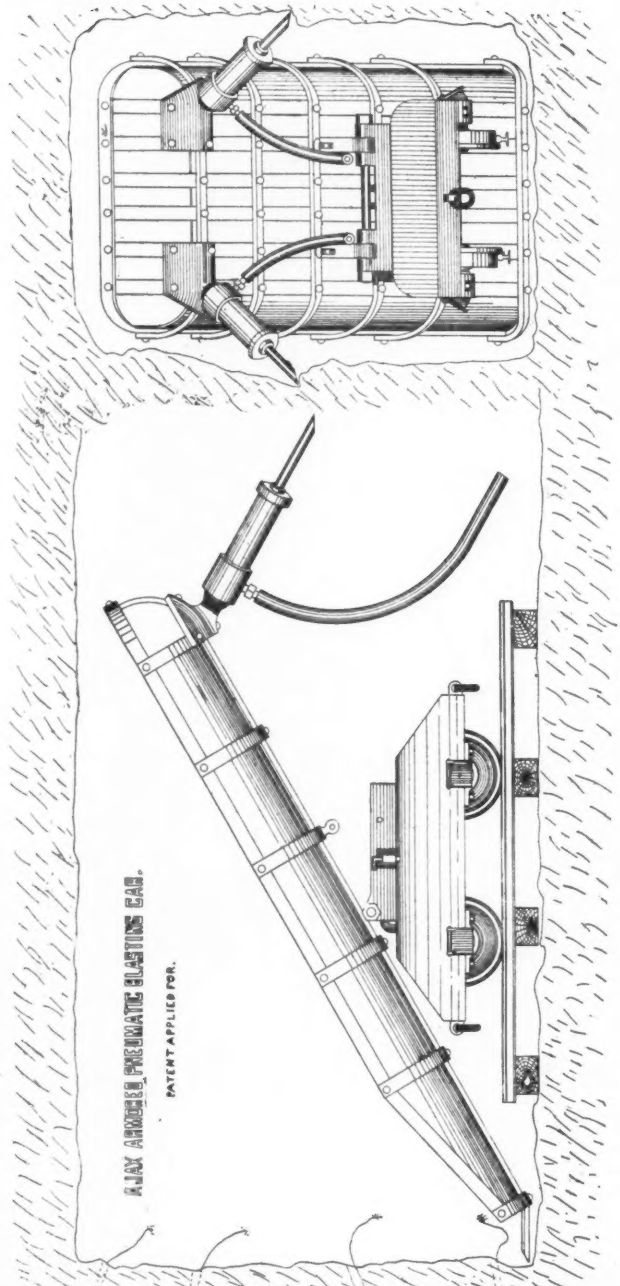
The body of this car is preferably made of what is commonly known as a scoop-shovel shape, being flat at the front or lower end, and having its sides bent up to permit of its holding a large amount of rock. It is made of a network of steel ribs, lengthwise and crosswise, which is covered with a heavy sheet of boiler plate steel of sufficient thickness to resist the force of the rock as thrown out by the blasts. When in position for receiving the shots, the rear end of this car is supported by means of two air lifts, or plungers, whose points are anchored into the side wall of the tunnel. The air hose connection used for running the rock drills are connected to these air lifts, and the air pressure in these lifts provide a cushion for the car, at the same time holding it in its position.

It is preferable, in placing this car, that a few shovels full of loose rock be spread on the lower end nearest the breast as a protection, as at this point the greater force of the blast is received. The angle at which the car sets and the cushion which the air lifts furnish, have the effect of breaking the force of the rock from the blast and effect a protection to the car.

The running gear of this car is provided with a ball-bearing turn table, which permits an easy turning around of the car. As it is essential that the car must be dumped from the opposite way from which it is loaded, for this reason the framework of the running gear is made the same at both ends, which will permit the car being dumped from either end or side. The air lifts, which hold the car in position, are provided with a ball socket for connecting on to the end of the car, and which are held in position only while under air pressure. As soon as the air is released these will fall out of position, and should a larger portion of the load be on the lower end of the car, the point of these can be placed against the back of the tunnel and used to press the car down into position for hauling out.

These cars are built to meet the requirements of any and all kinds of tunnel work. In case of double-track tunnel, two cars are used, one for each track, and come close together at the centre and will have their centre air lifts anchored between the rails. The cars are so constructed that there is sufficient room on each side for the miners to make their escape after having fired their shots. This also permits of the escape of the powder smoke from the blasts.

These cars will receive about 75 per cent. of the charge as it is thrown out from the blast, and unless very much more rock is broken than the car will hold, can usually be taken out in one or two loads. The advantage of this can be readily seen, as the great retarding element in driving any kind of a tunnel is the removal of the rock after blasting. These cars can be used for tunnel work



AJAX ARMORED PNEUMATIC BLASTING CAR.

PATENT APPLIED FOR.

or for drifting in mines. In the latter case, it will be found much better to load the common cars from this car at the station where the ventilation usually is very good than to push the cars into the drift and load them there. In such places where skips are used, the reloading of cars is not necessary, as this car can be dumped right into the bin or skip at the shaft.

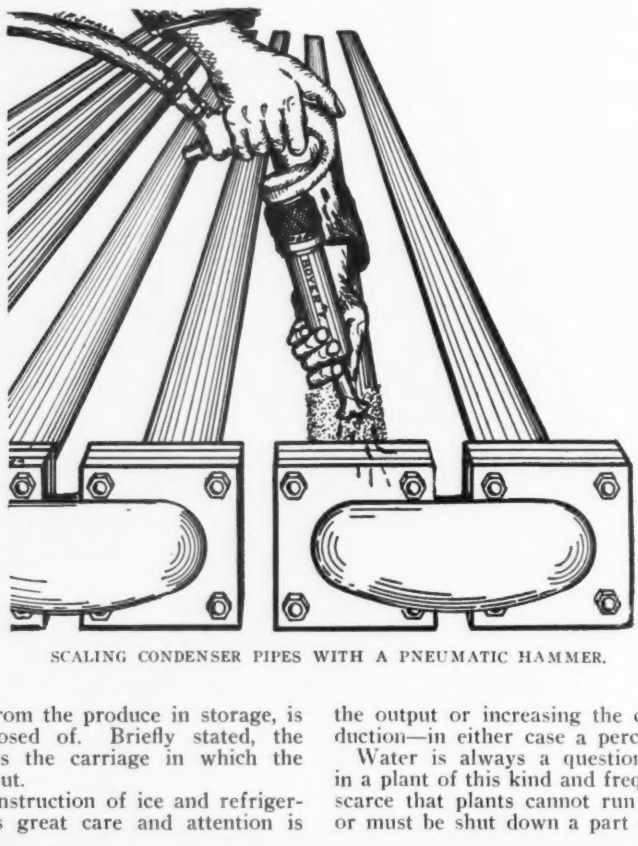
Scaling Condenser Pipes by the Aid of Pneumatic Hammers.

A very important part of all ice and refrigerating plants are the condensers, they being the medium through which the heat, absorbed from the water being frozen or from the produce in storage, is finally disposed of. Briefly stated, the condenser is the carriage in which the heat rides out.

In the construction of ice and refrigerating plants great care and attention is always given to the condenser's design, to secure the best results in efficiency. Although many experiments have been made in this direction, common practice has adopted one of two types of condensers, namely, the atmospheric or the double pipe condenser.

Many times a plant is most carefully designed, highly economical results are obtained during the first few weeks of its operation, but slowly the cost of production increases until its profits are decreased to an alarming degree.

Investigation usually shows that the management of the mechanical department is at fault, and that the machinery and devices about the plant are not receiving proper attention. Through neglect they become inoperative, thereby cutting down the output or increasing the cost of production—in either case a perceptible loss.



SCALING CONDENSER PIPES WITH A PNEUMATIC HAMMER.

Water is always a questionable factor in a plant of this kind and frequently is so scarce that plants cannot run to capacity or must be shut down a part of the time.

Numerous devices are employed to overcome the water problem, many of which have great merit; yet, too frequently, the condition of the condensers is not taken into consideration.

They are up above somewhere and water runs over them, yes, many times all the water that can be pumped is sent over them or through them, as the case may be. But still the compression gauge stands well up in the two hundreds, the ice in the moulds refuses to close and the storage room thermometers climb higher and higher. The cause of this condition is a simple one. The water used is impregnated with mud, alkali, magnesia or some other substance, which has been daily deposited on the pipes of the atmospheric, or in the pipes of the double pipe condenser, and baked there by the heat of the compressed ammonia gas or steam within them until the efficiency of the condenser is reduced from ten per cent. to twenty-five per cent. and from thence a perceptible loss through the entire plant.

It has been the custom heretofore to take hammers and pound the scale off the pipes when they are found to be scaly. This has been a dangerous and expensive method, for the pounders seldom struck the same blow, that is, some would not pound hard enough, while others would strike with force enough to crack the pipes and fittings, causing expensive repairs, loss of ammonia and time.

A valuable discovery in cleaning and scaling condensers has been made recently —a pneumatic hammer can be used to advantage, and is a time and labor saving device. A pneumatic hammer strikes rapid, uniform, light blows, which removes the scale instantly without danger of cracking pipes, fittings or springing joints, and requires but one-fourth of the time to clean a condenser that the old hammering method does. This means that the condensers have to be closed down only a short time, and almost a normal output may be maintained during the condenser cleaning operation.

The air pump now employed in all modern plants is usually large enough to supply air for such a hammer, therefore, the hammer will pay for itself in few cleanings, and is a blessing to all who are now using them.

The accompanying sketch illustrates the operation of a scaling hammer and form of tool used.

We are indebted to Mr. A. P. Anderson of the Consumers Ice Company, Chicago, for directing attention to the advantages of applying the pneumatic hammer to this service. A Boyer hammer, size F, made by Chicago Pneumatic Tool Co., was used by the Consumers Co.

J. FRANCIS SMALL.

The Köster Air Compressors.

Engineering, an English publication, describes and illustrates several new patterns of the Köster air compressors, now being introduced by W. H. Bailey & Co., Limited, of the Albion Works, Salford, England. Sectional illustrations of one of these, a belt-driven type, are shown herewith.

As will be seen, the compressor is of the two-stage type, the first stage of compression being carried out in the back of the cylinder and the second stage in the annular space *K*, between the cylinder walls and the body of the annular piston *P*. The air distribution is controlled by a couple of piston valves, *L* and *C*, driven by a single eccentric, as shown. The only gland packing used is one for the valve rod, ordinary piston rings being used elsewhere to maintain tightness.

On the suction stroke the piston valve *C* occupies the position shown in Figure 4. Air is then drawn in through the opening *A* and the port *B*, filling the back of the cylinder. Any air imprisoned behind the piston valve *C* escapes through the spring valve *D* into the intermediate receiver. On the return stroke the valve *C* has moved to the right of the port, to the position shown in Figure 3, and the air is then compressed out through this port and through the spring valve *D* into the intercooler, which, as indicated in Figure 3, is mounted on top of the compression cylinder. From the intercooler this air passes into the supply chamber *H*, where it is, during the back stroke of the piston, drawn into the annular space *K*, the piston valve *L* being then in the position shown in Figure 3. Any leakage between *H* and *A* is prevented by the piston *N*. On the return stroke the air in the annular space *K* is forced out, as indicated in Fig-

ure 4, to the spring valve *M*, raising which it passes into the main air receiver.

It should be noted that the positive opening of the valves ensures that the the opening of the inlet to the cylinder, the closing of the inlet, and the closing of the discharge port, are all mechanically controlled, the lifting of the discharge

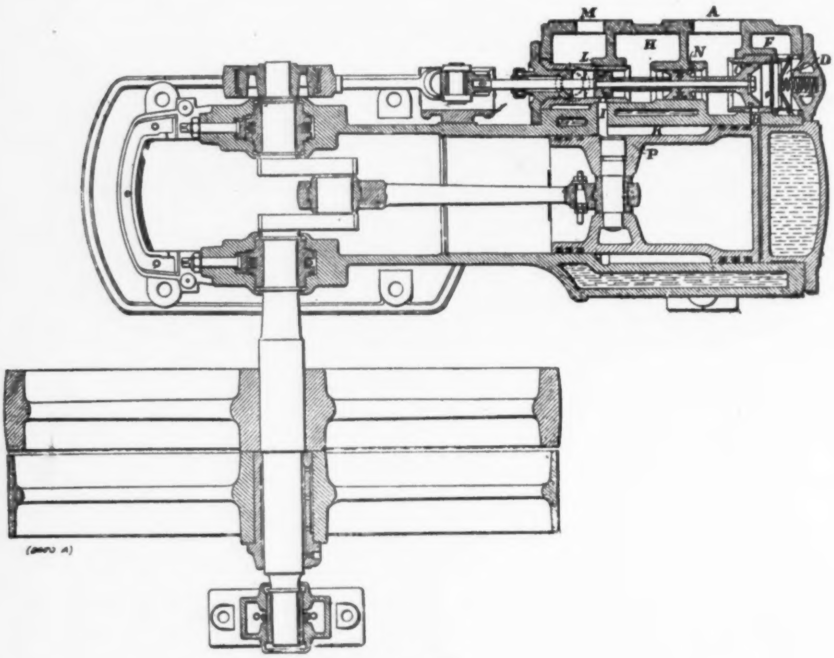


FIGURE I.

cylinder is filled quite full with air on its suction stroke. Further, as will be seen on reference to Figure 4, the valve *C*, in opening the cylinder port to suction, expels through the spring loaded valve *D* the compressed air in the clearance space between it and this valve. At the end of the stroke, again, the piston valve closes the discharge port, so that it is not necessary that the spring valve is specially prompt in its action, and, as a matter of fact, the spring actuating it is so light that the total pressure on it is only equivalent to about a couple of ounces, reckoned on its whole area. It, therefore, closes gently, without noise or shock, and, consequently, is little subject to wear. The same considerations apply to the delivery valve *M*, leading to the main receiver. Summing up, it will be seen that

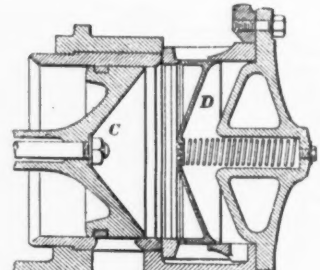


FIGURE 2.

valves being the only operations effected by the air pressure. The small spring pressure on the delivery valves also re-

duces the difference between the maximum pressure in the cylinder and that in the receiver, which, in view of the high

The cylinder is water-jacketed throughout, and the clearances are kept as small as possible. To give ready access to the

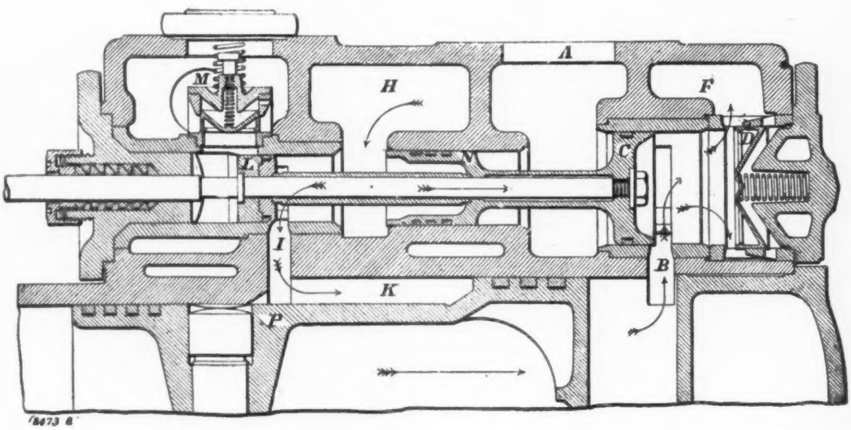


FIGURE 3.

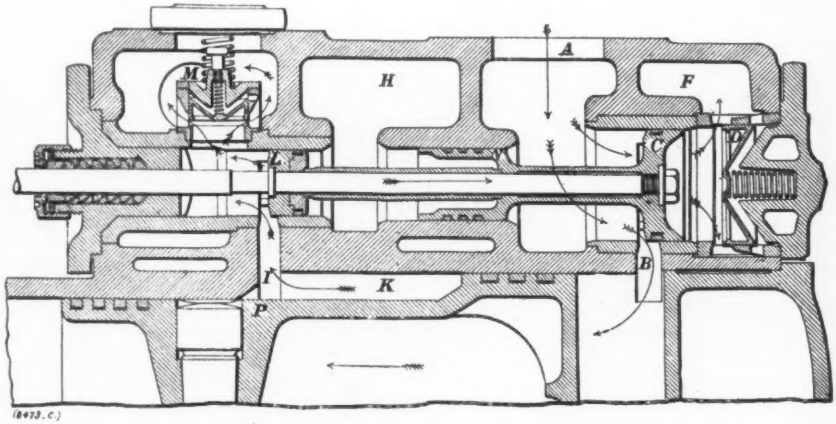


FIGURE 4.

speed at which the compressors are worked, might otherwise be high.

spring valves *D* and *M*, the covers shown are provided.

The Simplon Tunnel.

The piercing of the Simplon tunnel a few days since, says *Page's Weekly*, is the culmination of one of the most striking engineering feats of the present day; it is a remarkable instance of the triumph of mind over matter. The long anticipated juncture of the north and south sections of tunnel appears to have admirably fulfilled the calculations of the engineers. Napoleon's road over the Simplon was commenced in 1800 and finished in 1806. It still offers the route for those who are in search of scenery and whose time is unlimited. The new tunnel pierces the Alps at a lower elevation than any other route, viz., at 2,300 feet above sea level.

With the exception of a short curve at each extremity, the route follows a straight line. It is a double tunnel, with two parallel sections, 55 feet from centre to centre, each designed to carry a single line of rails. As yet only one of these has been constructed completely. The other, consisting at present of a gallery some 6½ feet high by 10 feet wide, is used for ventilation and purposes of construction. According to the international agreement between the two countries, it need not be completed as a second tunnel until the gross receipts from traffic between the tunnel termini exceed £3,218 per mile per annum.

The exact length of the Simplon tunnel is 19,731 kilometers (12¼ miles); it is, therefore, by several miles the longest tunnel in the world. The mountain towers above it over 5,000 feet on the average, and 7,000 feet at the highest point. Cross-headings connect the two tunnels at intervals of 656 feet. The extreme height of the tunnel is 18 feet above rail level, its width varying from 14 feet 9 inches at the latter point to 16 feet 4 inches at a height of 6 feet 6 inches above rails. The centre of the tunnel is for a distance of 1,310 feet of wider section, in order to admit of trains passing. From this mid-distance there is a gradual slope to both termini—that on the north side having a ruling gradient of 2 per 1,000, while that on the south side has a ruling gradient of 7 per 1,000. The contract price for the tunnel is over £2,350,000; but, of course, the actual cost is as yet an unknown quantity.

The execution of this remarkable work has called for admiration all along the line, whether one considers the mechan-

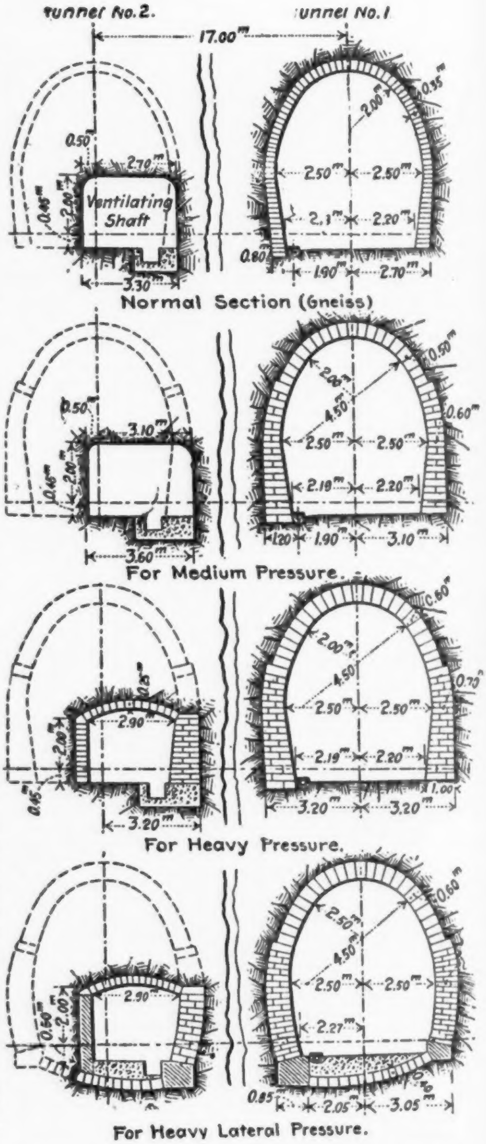


FIG. I—STANDARD SECTIONS OF SIMPLON TUNNEL.

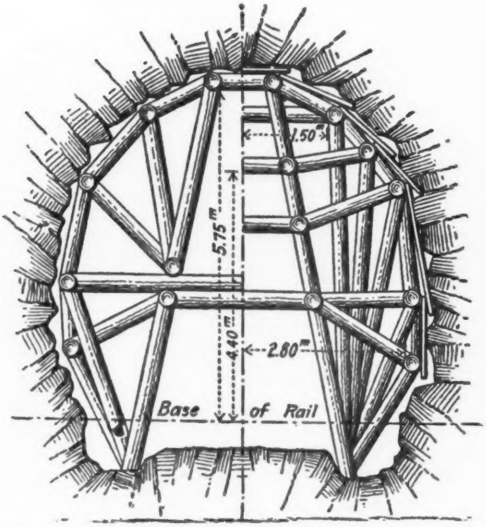


FIG. 2—STANDARD FORM OF TIMBERING FOR SIMPLON TUNNEL.

FIG. 3—EXTRA HEAVY FORM OF TIMBERING FOR THE TUNNEL.

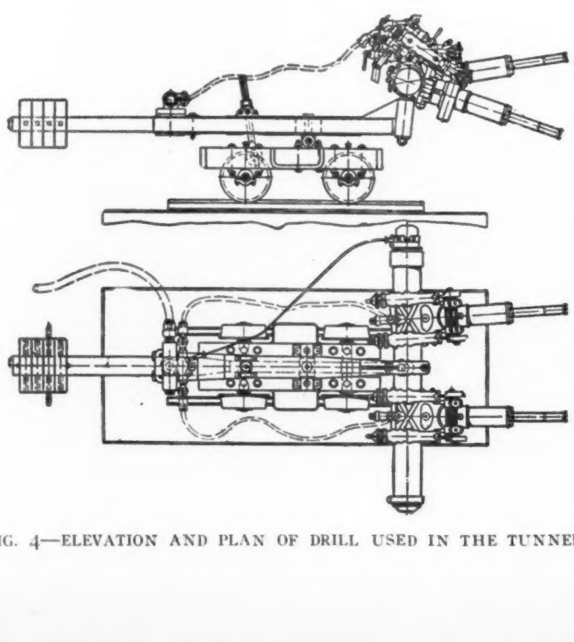


FIG. 4—ELEVATION AND PLAN OF DRILL USED IN THE TUNNEL.

ical perfection to which the contractors brought their machinery or the organization of the 3,000 men employed, who appear to have worked with an undivided enthusiasm and an almost military precision. It says something for the brains employed upon the scheme that, in spite of the most trying conditions, an excellent standard of health has been maintained among the workers, the most careful arrangements having been made to protect them from the dangers attaching to sudden changes of temperature and wet clothes. Most careful attention has also been given to vital questions of ventilation and commissariat.

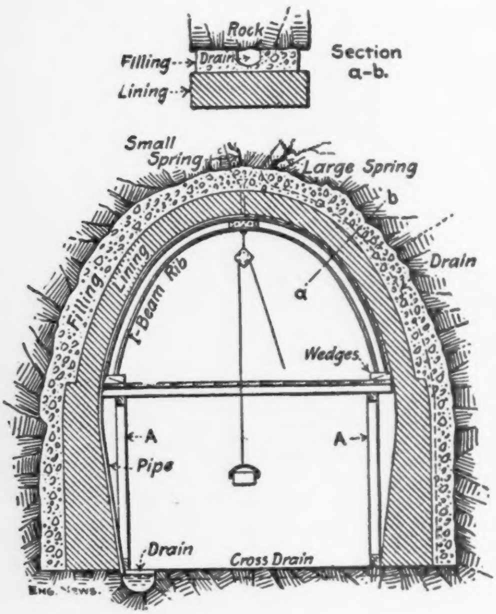


FIG. 5—DIAGRAM SHOWING METHOD OF CONSTRUCTING LINING.

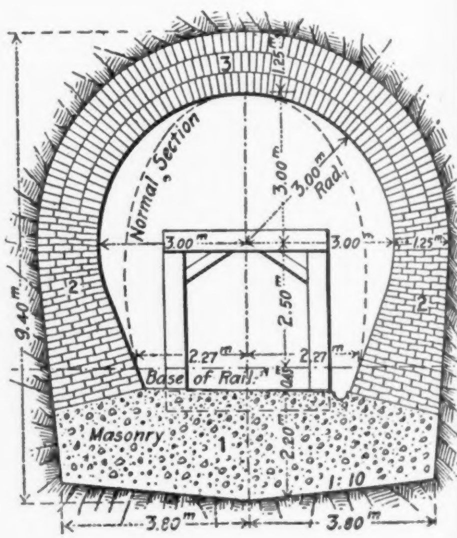
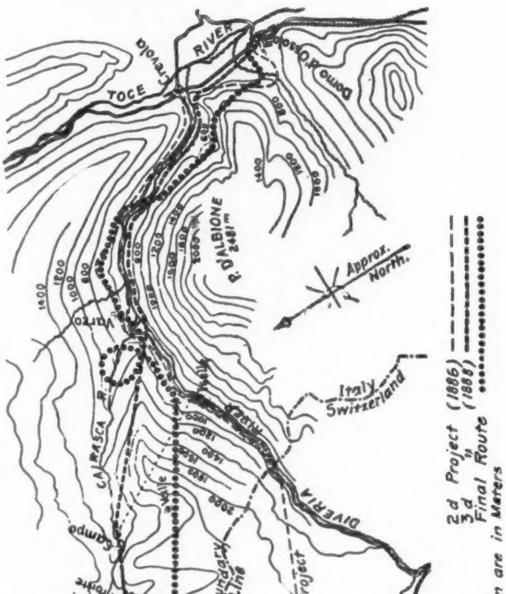


FIG. 6—LINING USED FOR HEAVY PRESSURES.

An important factor in the rapid execution of the work has been the drill shown in Figure 4. The feed of the rotary cutting tool is accomplished by the direct pressure of water in a large cylinder, the piston of which returns automatically when the water supply is cut off. The mandril carrying the boring bar and also the cutter are driven by means of two cylinders located above the feed cylinder. These cylinders operate a shaft having a worm gear which meshes with a worm wheel centered on the mandril. The cylinders are 1⅞ inch in diameter and their pistons have a stroke of 2⅜ inches. They are operated by hydraulic pressure, and each uses normally one litre of water per second. The two cylinders are connected by cross waterways and the piston of one acts as the valve of the other. The speed of the cutter necessarily varies for different densities of rock, but its highest speed is ten revolutions per minute. The drill, as described, is mounted in groups of two or more on a heavy iron thrust bar, about 12 inches in diameter. The figures are from the *Engineering News.*

In the process of excavation followed it has been usual to make an advance heading, 7 feet 10 inches by 10 feet 8 inches, by means of the power drills. This has been timbered and covered in for the passage of compressed air loco-

motives and trucks. From this a shaft was driven to the roof line every 164 feet, and from these the tunnel has been opened out both ways to the complete section. Dynamite and blasting gelatine have been the explosives used at the Italian and Swiss ends respectively, and, as a rule, eight blast holes were drilled at the face, the machinery and men being withdrawn for refuge to the cross galleries or service tunnel. In 1898, 1,342 feet were bored, each of the successive



MAP SHOWING PROPOSED ROUTES OF SIMPLON TUNNEL.

years up to and including 1903 being responsible for over 11,000 feet, while in 1904, 5,457 feet were excavated, and during the present year 557 feet have been taken out. The work, of course, proceeded simultaneously from both ends, but in May last driving at the Brigue end was stopped by hot springs.

An engineer connected with the work deals in the *Times* with some of the difficulties encountered. The gradient ascends from each entrance toward the middle of the Alps for drainage purposes, and it is due to this that it has been possible to carry on the work, as the yield of the great springs flows away by gravitation. At 4,400 meters from the Italian entrance a very large spring of cold water of 12,500 gallons per minute—in fact, a river—was struck, and this caused several months of delay at this end of the tunnel. The ground was very treacherous, so that it had to be heavily timbered; the stoutest and largest timbers were crushed, and steel girders had to take their place; but so great was the weight that these were twisted and distorted, and finally were only held in their place by being strengthened with concrete in cement. This enabled the driving of the gallery to proceed, but meanwhile the Brigue end had reached the top end of the gradient in the middle of the tunnel, although the rock temperature had risen to 132 degrees F., fully 25 degrees more than had been expected. With a view to saving time it was then decided to continue this and drive down the Italian gradient to meet the corresponding tunnel coming up from Iselle, although it was quite anticipated that difficulties would be met with in driving down hill. In this the contractors were not deceived, for very soon hot springs of 111 degrees F., and of considerable volume, were met with. These springs are far hotter than is bearable, but the engineers adopted the comparatively simple expedient of throwing jets of cold water into the fissures and thus reducing the temperature as far as was necessary. The cold water is driven into the tunnel by centrifugal pumps, through pipes surrounded by non-conducting material, so that the water is delivered as cool as possible.

Meanwhile the work at the Italian face was pushed on, until in September last another hot spring of 114 degrees F. was encountered in each of the parallel galleries, amounting to about 1,800 gallons per minute, and considerable difficulty and great delay were caused. By dint of extraordinary perseverance and courage, these springs were passed and soon left behind by the drill. The volume of water then emitted from the tunnel was still about 12,000 gallons per minute. When the actual junction of the galleries was effected the accumulated hot water on the Swiss side found its escape into the south gallery and was discharged into Italy.

The work that now remains to be done is to put in place the masonry arching, to cover over the water channel beneath the floor of the tunnel, and to lay the permanent way.

Compressed Air and Defective Installation of Air Plants.*

In this the writer has endeavored only to put together such facts as have come under his observation in practical experience with air plants, which may be useful to engineers in the installation of air equipment.

Compressed air and electricity are the two new powers and are new fields for industrial research. Electricity has advanced beyond compressed air in the industrial march, as it has always had this strong point in its favor—that an electric plant must be properly installed; that certain fixed laws of science must be respected in the installation of electric plants has been acknowledged by engineers for some time, as the defective installation of electric equipment means that when it is placed in operation a series of difficulties will follow; that you will have short circuits, grounds, and burnouts of all kinds, and it may even be a menace to human life. With all of these difficulties confronting engineers, they have learned to respect the laws of science that apply to this particular power.

With air power it is different, for it is a safe power with which there have been too many unreliable experiments. A combination of human nature, business enterprise, and greed is somewhat responsible for the conditions we find about us which result in many points being overlooked by the prospective purchaser or actual user and quite as often being

*By Wm. Wilhelm, in *Mines and Minerals*.

disregarded by the manufacturer, either purposely or through ignorance. First cost of installation, in too many cases, is made the paramount issue. First, a compressor of too small a size is ordered. To this is added defective installation. A receiver of unsuitable size and design is used. The air is taken to the compressor, in many cases, through a duct leading from some room filled with dust and grit and to this is added a defective system of piping for transmitting the air to various places for different uses. The pipes are too often carelessly laid down filled with sags and pockets and are of too small a size to transmit the air required for the work and considerable loss follows, due to retardation by friction of the pipes. An insufficient supply of cooling water is furnished by the water-jacket for intercooling purposes.

In some plants all these faults exist and you will find the owner of them condemning the use of compressed air appliances and machinery, and all because he has allowed his own false standard of economy to run away with his judgment, and, like many of the human family, unwilling to admit that the fault is caused by his own bad engineering he seeks satisfaction by condemning the art. We often, in air plants, find that nearly all the rules and laws pertaining to the work of compressing, to transmitting, and to utilizing air power have been ignored. And with all these faults it is a power so simple that it does not refuse to work although its efficiency may be cut down 50 per cent. Compressed air will exert the force that remains in the same safe way, because, unlike electricity, it cannot resent the wrongs that have been thrust upon it.

In designing and installing a compressed-air plant there are many rules and laws applying to the art that engineers should observe in order to procure economical and useful results.

In selecting compressors for permanent installation when 100 pounds air pressure is required, the same care should be taken as one would take in selecting an engine to run an electric plant. A two-stage compressor should always be specified because the great advantage derived in compound compression is the economy due to intercooling between the stages which not only reduces the units of work required to compress the air, but produces drier air. This matter of dry air is a valuable consideration when the compressed air is to be transmitted to a distance. A further benefit may be derived by using an aftercooler which serves to reduce the temperature of the air to the dew point and collects the moisture before it is discharged into the mains and transmitted to various distances for different uses. Dry air prevents frosting in the transmission pipe in cold weather, and frost in the exhaust passages of drills and other tools is eliminated.

Taking the foundation for a compressor we often find this of unsuitable design and construction, and a poor foundation, in many instances, means a badly running compressor. Foundations for compressors should be built of either brick or concrete and should be of sufficient length to take up the thrust caused by the motion of the traversing piston.

Taking the air end of a compressor, the conduit for free air leading to the compressor should be at least double the size of the inlet pipe. This should be covered with a fine woven wire cloth. The advantage of supplying cool air is well worth considering and the free air should always be taken from the coolest place obtainable. For every 5-degree reduction in temperature of the air entering the compressor, there is a gain of about 1 per cent. in its volumetric efficiency. The pipe to the receiver should be the full size of the compressor's discharge opening and should have as few turns as possible. The use of long turn fittings is recommended. The receiver should be of sufficient size and located in the coolest place obtainable, for it is important that the air is cooled as much as possible in the receiver, thus collecting most of the condensed moisture and oil from the air at the bottom of the receiver where it can be blown out.

In regard to circulating water, a liberal supply for cooling purposes must be furnished to remove the heat generated by compression. This heat, if not removed, greatly increases the power required to compress the air to a given pressure, but also renders the cylinder lubrication less effective. If water must be used economically, it may be utilized for other purposes after leaving the compressor, as water as pure as it is possible to obtain should be used for cooling purposes, as dirty and impure water in an intercooler and cylinder jacket has much

the same scaling and corroding effect as it does in the ordinary steam boiler.

In the first installation of air pipes due care should be taken in the design. The engineer should be sure not only that they are large enough to transmit the air required to do the work at the present time, with a reasonably small amount of loss due to the friction in transmission, but also that ample allowance has been made for any new uses he may find for air and for any tools that he will be continually hitching to the system. Consideration must be given to the fall of pressure due to the resistance of the wall surface of the pipe. The pipe should be installed large enough to overcome this.

Generally in compressed-air transmitting systems, the air is delivered into the mains at a temperature above that of the surrounding air, or of the earth in underground lines. The excess of heat is soon absorbed by the surrounding medium and in long lines the transmission may be said to be isothermal. The loss of pressure in transmission in most cases, is independent of any change in the temperature, being directly in proportion to the length of the pipe lines and the square of the velocity and inversely as the diameter of the pipes.

At the ends of long pipe lines separators should be placed for collecting the condensed moisture from the air at a place where it can be blown out, thus preventing the intrained water from going through the tools and different air appliances.

In the writer's experience he has found that by conforming to the rules which apply to air power, much better results could be obtained than by going about it in a careless manner, and while air power is often considered a mere matter of convenience its economical side has been much neglected and even abused.

Care of Pneumatic Tools.*

General.—The first and most important point is to see that the tools get a full supply of air at a pressure at from 80 to 100 pounds per square inch at the tool. It has frequently happened, where the air is conveyed for some distance through hose, that it is reduced at certain points down to the tool, and the result is the hose is eventually so small that the tool does not get the proper volume of air and will not work with full efficiency. Wherever possible to operate a drill coupler to a three-quarter hose the best result will be obtained. Sections of 10 to 15 feet of ½-inch tubing will supply sufficient air to operate a hammer.

Air Strainers.—As a protection to pneumatic tools the manufacturers invariably furnish an air strainer, which should be applied to the line at the hose connection for the purpose of removing foreign matter which may have been sent into the line through the compressor. At times the air is drawn from places where it is extremely dirty. The dirt passes through the compressor and out through the line into the tools, causing them to refuse to properly operate, whereas, if the strainers are applied as above indicated, the principal foreign matter is accumulated and can be removed at intervals. The Keller tools have the strainer located in the nipple, which is screwed into the throttle handle. Too much care cannot be exercised in this direction, and many air-tool failures are directly chargeable to carelessness in this direction. Where strainers are used, if the tool at any time should show a decrease in efficiency, the strainer should be immediately examined, as in all probability it has become clogged with foreign matter.

Oiling.—All pneumatic tools when in use should be oiled once every hour with good, light oil. Pneumatic tool manufacturers, as a rule, supply a high-grade oil at very reasonable prices. Never use heavy oil. The expansion of the air in passing through the tool causes ordinary oil to become thick and gummy. This interferes with the free movements of the parts, besides closing up the small air ports. Some manufacturers make an automatic oiler, which is placed about 20 inches from the hammer or drill, with a short connection of oil-proof hose between the oilers and the tool, which it has been found to be invaluable for the purpose designed. These oilers work on the same principle as an atomizer, the flow of the oil being regulated by a small pin valve, which is adjusted by means of a screwdriver to give any desired flow, thus lubricating the air constantly as it passes into the hammer or drill, thus insuring each and every part being constantly lubricated

* By George A. Rees, in *The Boiler Maker*.

lightly, and has been the means of increasing the efficiency and life of the pneumatic tool largely. Large users of pneumatic tools find, by the use of the automatic oiler, it enables them to fill this oiler when the tools are issued from the tool room each morning, thus insuring the proper lubrication of the equipment through the entire day, enabling them to dispense with the services of oilers, whose duty it was to circulate through the work and oil the tools at intervals. By dispensing with the services of one or two men the small self-lubricator soon pays for itself.

Hammers.—Too much attention cannot be paid to the systematic cleaning of all pneumatic tools, and no other class of machinery will show larger returns for care thus bestowed. When the hammers are returned to the tool room at the close of the day they should be suspended in a bath of benzine or gasoline, where they should remain over night. In the morning, before being issued to the workmen, they should be removed from the bath and connected to the hose and thoroughly blown out, after which a sufficient quantity of the proper lubricating oil should be injected into the handle at point of hose connection, the valve opened by means of the throttle lever, thus allowing the oil to find its way into valve in the proper manner, that they may be thoroughly lubricated before placing them into the hands of the operator. Where pneumatic oilers are not in use, if the workmen have sufficient interest in the equipment, it has been found convenient and profitable to place into the hands of each operator a small oil can, that he may lubricate his hammer at intervals of about one hour. Kerosene should rarely ever be used, as it is a difficult proposition to blow out the hammer thoroughly, and where there is a slight trace of kerosene the light lubricating oil will not adhere to the parts, but is carried off by the exhaust of the air, and before the operator can realize what is taking place the hammer becomes dry, parts expand and the tools refuse to operate. Great care should be exercised at all times to see that the parts are free from dirt, as there are in some designs of hammers small parts which easily become clogged, due to the accumulation of dust in the oil used for lubricating purposes.

Care should be exercised to see that the handles on the riveting and chipping hammers are always kept thoroughly tight; practically all these tools have a proper locking device for holding the handle where it is screwed home, and in case of trouble this is one of the first points to receive attention.

Pneumatic tools as a whole are generally badly abused. One of the latest abuses is the substitution of a short piston for piston of standard length. Each hammer, when designed and placed upon the market, is constructed with all parts in proper relation to each other to develop the power required for the work intended, and each part to withstand the strain to which it is subjected. A piston ¼ inch short will hit a much more powerful blow, but it will be only a question of a few hours until the piston will crumble the small parts thus broken off, will cut the inside of the cylinder, and if the hammer is not destroyed in this manner it will be a question of only a short time until the broken parts will become wedged at some point and split the cylinder, or it may be found the piston on the return stroke will not supply proper cushion, thus permitting it to strike the hammer, with the result that handles are broken. Where broken cylinders, pistons, handles or rivet sets are experienced frequently, an examination should be made to ascertain whether or not these short pistons have been substituted. Manufacturers should certainly not be held responsible in any manner whatever for damages thus occasioned.

Generally speaking, pneumatic tools have been in use a sufficient length of time for all branches of the service in which they are used to have become thoroughly familiar with their care and operation. However, the above remarks will not go amiss, should they be the means of enlightening a very small percentage of the manufacturing fraternity.

Inlet Valves for Air Compressors.

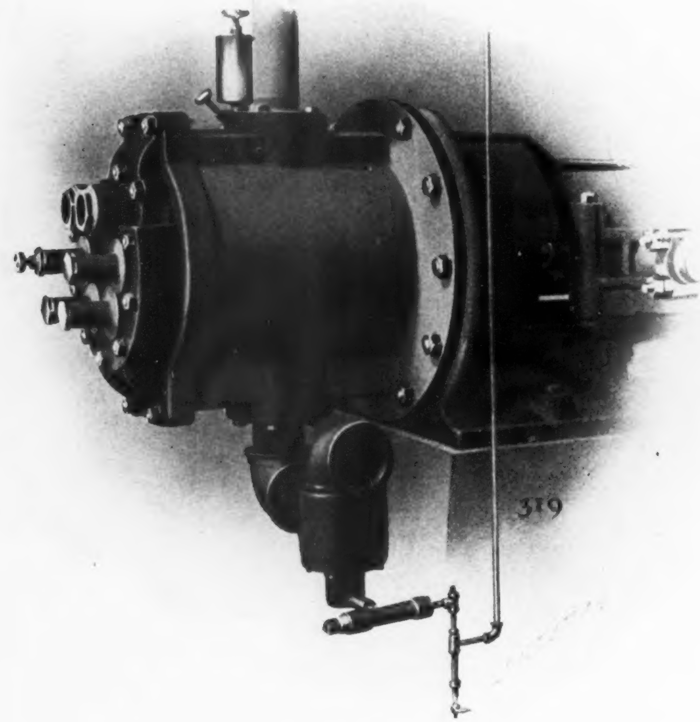
As the first requirement is to get the free air into the cylinder, the most important of the air valves are the inlet valves on the low pressure or intake cylinder. Good inlet valves should permit of very large passages leading to them, so that the free air will reach the valves practically unhindered. Then the port areas through the valves should be large,

so that but little suction will be required to draw the air into the cylinder. The valves should be in the heads, so that the air will have little chance to get heated on its way into the cylinder. This heating of the intake air is a source of loss that should not be overlooked, for every five degrees that the air is heated before compression means a loss of one per cent. in capacity and a waste of one per cent. in power. When it is considered how easily air becomes heated by passing over hot metallic surfaces, it will be seen that there may in some cases be a large loss due to this cause. This loss is hard to measure, but for that reason every precaution should be taken to avoid it.

Inlet valves should close promptly when the crank passes the centre, otherwise some of the air will escape before compression begins. This slip is a very serious fault with some styles of valves, especially those which have neither gear nor springs to close them.

When closed, the inlet valves should not leak. Leakage is a fault which depends largely on the designs of the valve, as properly designed poppet valves and Corliss valves tend to become tighter as they wear. A valve which has a tendency to wear leaky is, of course, always getting worse, and should be avoided.

Clearance also causes a reduction of capacity, and should be kept low. Its im-



INTAKE UNLOADER.

portance is sometimes overestimated, for clearance represents a loss of capacity only, while suction heating of the air slip and leakage not only reduce the capacity, but waste the power. In addition to this, clearance is a constant quantity and may be completely covered by making the cylinder slightly larger in diameter, while the other losses mentioned are variable and may grow from bad to worse.

For the inlet valves on the low pressure cylinders of the Canadian Rand Drill Co.'s compound compressors they have adopted a single-ported Corliss valve, driven by a special valve gear. With this gear we are enabled to get a quicker and wider opening for the same diameter of valve than that obtained with any other positive gear now in use. This enables us to get a very large port area, usually twelve and one-half per cent. of the piston area, while at the same time the clearance is kept very small. The passages leading to the valve are still larger than the ports, usually from eighteen to twenty-five per cent. of the piston area. The valves are in the heads, so that the air does not come in contact with any heated surfaces before it enters the cylinder. Being positively driven, the valves close at the end of the stroke, thus preventing any slip. Being of the single ported type, and lying directly above the port, the valves tend to wear tight rather than leaky.

On power-driven machines is provided an unloading device in the intake pipe. When the air pressure rises to the limit for which the unloader is set, it shuts off the supply of air to the compressor and reduces the power required to the mere friction load. When the pressure falls a few pounds, the valve opens again, admitting air to the cylinder. This device may be adjusted to suit the pressure required while the compressor is running. —*Canadian Machinery.*

Suggestions for Running Air Compressors.*

In offering the following suggestions and hints, we may be criticized by some for referring to some points which may seem so simple that they are hardly deserving of attention, but we find from experience, that often the neglect of some very simple detail is the source of much trouble and annoyance. We have, therefore, inserted some matter that may be superfluous to the experienced engineer, but which we trust may be of some assistance to those who have not had an opportunity to acquire the experience, and yet with the ever broadening field in the use of compressed air, find themselves called upon to take charge of an air compressor.

Compressors of large size are usually installed by the regular erecting engineer sent out by the builders, and he attends to the setting, adjustment, and preliminary trials, and gives to the operating engineer such explanations and instructions as seem necessary to fit him to properly handle and care for the machine. The use of compressed air has become so extensive however, and in many instances the compressors are of such small size that the expense of sending a man, perhaps a long distance, to attend to the installation seems unwarranted, and so it often devolves upon the engineer in charge of the plant. On this account a few remarks regarding the setting may not be out of place.

Most of the smaller sizes of compressors are more or less self-contained, and the alignment is maintained by a bedplate, or other arrangement of attached parts. Without, therefore, going extensively into detail, and assuming that the foundation is already prepared, we would say that the two principal points to be observed in the setting are the leveling and grouting.

For leveling the machine iron wedges should be inserted between the base and the foundation. These should be driven in until it sets level and bears firmly and equally on them all. The method of supporting at only three points, which is advocated by some, is all right if the machine is quite small and very rigid, but with many types, support at three points is insufficient and the weight of the portions overhanging the supports tends to distort the structure. A good plan is to put a wedge next to each anchor bolt. When the machine is supported thus on the wedges, there should be a space of at least half an inch left between the base of the machine and the foundation, to allow for the grouting. A dam should be built around the base and about 4 or 5 inches in height. Into this enclosure pour a mixture of Portland cement and water about the consistency of thick cream; puddle it well under the edges to remove

* By M. W. Sherwood, M. E., Rand Drill Co., in *Mines and Minerals.*

any air bubbles. If the base of the machine has a good broad surface, a part of the cement, not exceeding one-half, may be replaced by fine sharp sand.

After the grout has set, but before it becomes hard, the dam may be removed and the edge trimmed off neatly.

The time and expense involved in the proper execution of the work just described is well invested, and will contribute more to securing the satisfactory operation of the machine than many realize.

This being accomplished, the steam and exhaust and air piping should be connected, which we will not dwell upon, except to advise that the steam pipe be thoroughly blown out with a good pressure of steam before making the final connection to the compressor.

The construction of a compressor is much the same as that of a steam engine, and many details will be found exactly the same. The principal difference is found (or should be) in the sizes and proportions of parts. The stresses in a compressor are far more severe than in a steam engine, and in the best makes, the bearings and various working parts will be found to be much heavier than in a steam engine developing the same indicated horsepower.

Another point of difference, and one that must be borne in mind, especially in making adjustments, is the fact that the clearance is very small as compared with that of a steam engine. The volumetric efficiency of the compressor depends, among other things, upon the amount of clearance: the smaller the clearance, the higher the volumetric efficiency, and on this account the clearance is reduced to the lowest practical limit, it being as small as $\frac{3}{32}$ inch at each end of the cylinder, even on machines of large size.

As the bearings wear and are taken up, the effect in most machines is to bring the air piston nearer to the crank-end of the cylinder, and on account of the small clearance, with repeated adjustment, it might soon be brought dangerously near the head. It seems almost incredible, but the writer has met with one instance where, through a neglect of this point, the piston has been striking the head until outlines of the perforations on the guard plate had been plainly stamped on the piston. It is needless to say that the machine broke down.

The clearance in the air cylinder should, therefore, be measured occasionally, even when the adjustments are slight, and always when the amount taken up is considerable. This is so easily done that there is little excuse for omitting to do it. There are very few compressors in which it is not an easy matter to reach the space between the piston and cylinder head by removing an outlet valve. To measure the clearance, therefore, remove one of these valves and insert the end of a small bar of lead, so that it will come between the piston and the face of the air head, and then turn the machine over the centre. The thickness of the lead where it has been squeezed between the piston and the head will show the clearance, and the clearance at the other end may be obtained in the same way, and the two compared. The necessary adjustment should be made to have it about equal. If the construction is such that the piston rod screws into the crosshead, the adjustment is usually made at this point.

In very long machines, the clearance at the front, or crank, end of the cylinder should be a little less than at the opposite end, to allow for a slight increase in the length of the rods, on account of the expansion of the metal due to the higher temperature it has when the machine is in operation.

The adjustment of the various bearings is the same as on a steam engine, and any one who is familiar with the latter needs no special instruction. However, for the benefit of those who have not had experience on a steam engine, we offer a few suggestions, although it is difficult to give instructions that will apply in every case.

Generally speaking, it is considered best to run a bearing as tight as it can be run without heating, as a knock due to looseness is not only unpleasant to hear, but is much more injurious to the bearing than the wear due to the mere rubbing together of properly lubricated surfaces.

When a bearing has been running satisfactorily and requires only to be taken up for a slight amount of wear, it is sufficient to note the position of the screw, or wedge, and then advance it a very little, and after some experience with the bearing it will be possible to judge quite accurately the amount it requires to be taken up. In adjusting a bearing which is entirely slack, the commonest method is

to set the adjusting screws, or wedges, up so that the bearing surfaces will be tight against the journal, and then slack off an amount that seems to provide the necessary freedom. Personal judgment will have to determine this amount. Where the adjustment is by a setscrew, from an eighth to a quarter of a turn of the screw is about right. It is better to start with the bearing a little too loose than too tight.

Where there is more than one adjusting screw, as in a main bearing of considerable size, this method will secure as nearly as possible the same adjustment at both ends of the box. Where the main bearing is provided with quarter boxes, which are adjusted by means of setscrews through the pillow block, the adjustment can be made very satisfactorily while the machine is in operation by loosening the jam nuts and adjusting the setscrews with the fingers, screwing them up lightly when the shaft is pulled over against the opposite side.

In spite of the utmost care, a journal will sometimes run hot. When a journal begins to heat, unless the heat is due to knocking instead of friction, the bearing should be loosened as quickly as possible; it cannot be done too soon, as no matter how well the bearing may have been running, when its temperature rises, the journal expands and it becomes too large to run freely, which increases the friction, producing more heat, and further expansion, so that the bearing soon becomes very hot.

It is advisable to keep the necessary wrenches convenient for such an emergency, so that no time need be lost in loosening the adjusting screws. After the bearing is hot, it will have to be supplied liberally with heavy oil, until it cools. On account of the high temperature, the regular oil becomes so thin that it does not properly maintain a film between the journal and the bearing. Cylinder oil usually is the most available heavy oil and should be used freely until the temperature of the journal becomes nearly normal. The bearing may then gradually be tightened again. Unless the bearing has cut, no serious trouble will be experienced.

When one bearing becomes hot those near it should be carefully watched as the heat may be conducted to nearby journals causing them to expand with the same results.

The air cylinder should be lubricated with the best grade of mineral oil of light body and high flash test. It should not be of a coking nature for if it is, it carbonizes on the inside surfaces of the air heads and valves and not only prevents the latter from proper action, but is frequently the cause of accidents. The air cylinder requires but a small quantity of oil, and after the machine has been running long enough for the cylinders to acquire smooth and polished surfaces, two or three drops per minute will be found a sufficient amount to keep the cylinder and its valves in satisfactory condition. Oil especially adapted for use in air-compressor cylinders may be procured.

There is danger of explosion if the oil used is not of high flash test, especially in single-stage compressors, where the temperature due to compression is high.

The valves should be removed every two or three weeks, and thoroughly cleaned. Even when the best oil is used, they will become gummy and dirty in time.

It is important to have an abundant and reliable supply of water for the cylinder jackets. It is advisable to have the piping so arranged that the flow of water may be observed at all times. The best arrangement is to have the water, after it leaves the jackets, discharge into an open funnel which is in plain sight.

In starting the compressor, it is well to adopt some system, following out a certain order in the various steps taken in getting ready to start. In this way there is less likelihood of anything being overlooked. A good plan is to first start the jacket water, then the lubricators and oil cups, and then the machine, and in shutting down follow the reverse order.

There is one final suggestion applying to many kinds of machinery and which, if strictly followed, will save many accidents. If at any time it is necessary to remove any parts for adjustment, inspection, or repair, after replacing them, be sure to turn the machine over by hand one complete revolution before putting it in operation.

Mr. Vernon H. Rood.

Vernon H. Rood, vice-president and general manager of the Jeanesville Iron Works, Hazleton, Pa., died suddenly, September 2d, at Bad Naudheim, Germany, where he had gone for the benefit of his health three weeks ago.

Mr. Rood was 48 years old. He was born in Elyria, O., November 10, 1856, and was a son of the late Homer B. Rood. He was a graduate of the Stevens Institute of Technology. He was married December 21, 1882, to Miss Alice A. Stone of Oberlin, O. Shortly after his marriage he located at Jeanesville. He was a prominent member of the American Society of Mechanical Engineers. For the past 15 years Mr. Rood had devoted his entire time and energy to the perfection of mine pumps and during that time he achieved a great deal of success. Not only did he bring the Jeanesville Iron Works from the position of a small local manufacturing plant into that of the largest makers of mine pumps in the anthracite fields, but his name as pump designer has spread to a world-wide reputation and the business of his company is to-day an international one.

Much as his sudden loss will mean to his profession, it will be a greater and more poignant affliction to his hosts of friends. Mr. Rood's was a strong, just and kindly personality. Those who were his friends, and no man ever met Vernon Rood without desiring to be numbered among them, will mourn deeply for the hearty hand-clasp and the loyal sympathy with which he was always ready. Though reserved to a degree about his own trials and anxieties, no man was ever more ready to share those of his friends. We who knew him feel that it will be long before time can heal the wound his going makes.

Notes.

Compressing air to 100-pounds gauge pressure requires approximately 1½ horse power per cubic foot of air compressed.—*Ex.*

Air-cooled transformers are usually arranged to receive air from a blast system carrying from ¼ to ¾-ounce pressure.—*Ex.*

Assuming the air consumption of a 3¼-inch drill as unity, that of a 2½-inch is 0.445; of a 3 5-16-inch, 1.069; that of a 3⅝-inch, 1.123.—*Ex.*

When a rock-drill is not in use, it is important to keep the valve and piston well oiled; otherwise rust will rapidly eat away the machined surfaces.—*Ex.*

It does not ordinarily pay to overload an air compressor with more drills than it is designed to carry, and it never pays to use a main pipe so small as to reduce the air pressure materially.—*Engineering and Mining Journal.*

Compressed air is usually used at from 65 to 100 pounds pressure. In torpedo practice, however, and in street-car work, pressures as high as 2,000 pounds per square inch are used.—*Engineering and Mining Journal.*

The use of air instead of steam for drilling in all underground workings is advised. A drill using air is a great ventilator, driving out smoke and noxious through the loop and against the pipe, pressure upon it tightens the rope and gives a grip that will hold to a surprising extent. The rope must be wrapped, of course, in a direction opposite to that in which it is desired to turn the pipe.—*Engineering and Mining Journal.*

When a drill-bit sticks in a hole, the usual remedy is to strike the shank violently with a sledge, until the bit is loosened. It is better to strike a moderate blow on the shank, near the hole, and never so high up as to strike the chuck, because then a bent piston or a broken chuck is likely to result. Small pieces of cast-iron, nuts, or other fragments are used to keep the drill straight and prevent sticking or "running off."—*Engineering and Mining Journal.*

A test of 31 drills at the Rose Deep mine, South Africa, showed an average consumption of 81 cubic feet of free air per 3¼-inch drill per minute, including all leakage of pipes. The compressed air averaged 70 pounds per square inch. Each drill consumed the equivalent of 43 pounds of coal per hour. The compressor engine showed an average of 12.7 i. h. p. per drill. The mechanical efficiency of the

engine was 86 per cent.—*Engineering and Mining Journal.*

With machine drills having about 3-inch pistons and operating under about 90 pounds pressure, 45 to 50 feet of holes in an eight-hour shift is considered a good day's work in hard rock—greenstone, granite, quartz-porphyry or other similar hard, massive and unaltered rock, that is not softened by weathering or decomposition, for some hard and tough rock becomes very soft on being subjected to alteration by atmospheric or chemical agencies, such as solfatara.—*Mining and Scientific Press.*

The rate of drilling in soft rock can be increased by the use of a water jet to wash the sludge out of the hole as fast as it forms. A water-nozzle, which may be a piece of ¾-inch gas pipe drawn down to a fine point at the end, is pushed into the hole as the drill advances. The water may be supplied under air pressure, or by gravity from an upper level. In rock that makes sludge rapidly, a drill using water under pressure will easily surpass those which depend upon the "chuck-tending" of the drill helper.—*Engineering and Mining Journal.*

A press dispatch from England says: "A good deal is being heard of the pneumatic hub which is to replace the ordinary rubber tire, with a great saving of rubber. I am told in one quarter that the idea is an old one, though it does not seem to have had much of a trial. Whether it is a novelty or not, a strong London syndicate is now engaged in developing it, and great results are expected. The claim is that by the fitting of a pneumatic cushion round the hub the same effect, as far as easy running is concerned, is obtained as in the case of the ordinary rubber tire encircling the rim."

It is estimated that for good ventilation in mines at least 100 cubic feet of fresh air should be supplied for each man employed underground. Some mines have ventilating plants which actually supply this amount, but the system of air distribution is so poorly arranged that in some places the fresh air is in excess of requirements, while in others it is deficient. It is evident that a single machine drill exhausting 180 cubic feet of air per minute when in actual operation supplies no more air to two men working there than they actually need, and that it falls below the theoretical requirements.—*Mining and Scientific Press.*

Halbert P. Gillette, M. Am. Soc. C. E., M. Am. Inst. M. E., and formerly associate editor of *Engineering News,* with George H. Gibson, A. M. Am. Inst. E. E., J. M. Am. Soc. M. E., formerly manager of publicity for the International Steam Pump Company, manager of the advertising department of the B. F. Sturtevant Company, and editor of the Westinghouse Companies' Publishing Department, have formed a partnership and opened an office in the Park Row Building, New York city, where they will do expert advertising work, calling themselves "Advertising Engineers."

The following question and answers were published in *Canadian Machinery.*

Q.—(a) Is it advisable to use compressed air to clean dynamos, &c., in a central station? (b) At what pressure? (c) Has the suction method used in house cleaning ever been tried on dynamos? (d) Would it not prevent raising dust through the air to fall later on the dynamos?

A.—(a) Yes, in every instance when possible. (b) At 50 pounds per square inch. (c) Not to my knowledge. (d) An excellent idea, and would prevent the dust falling back on machines, but would not reach the distances in small places, for instance between the armature and field coils or pole pieces, like an air blast.

One of the latest applications of compressed air to portable hand tools, known as a pneumatic ram, has been designed specially for the breaking of stay-bolts, the cutting out of rivet heads, driving drift pins, and similar service about boiler shops, work of a character which heretofore has been the exclusive stronghold of the boilermaker and his helper. The ram is suspended by means of a tackle. A slide valve located on the right-hand side of the machine permits the operator to deliver single, individual, but powerful blows to the work.

A valuable feature of the design is that the piston of the ram is automatically returned to its original position, ready for another stroke.—*Ex.*

The Sullivan Machinery Company, of Chicago, reports the addition of two branch offices to its list, one at Knoxville, Tenn., and one at Joplin, Mo. The Knoxville office, with quarters in the Houston Building, is in charge of Mr. E. L. Thomas, for several years connected with the New York branch. Rock drills, stone channelers and quarrying machinery are carried in stock. Mr. S. A. Allison, who has been the company's representative at Joplin for the past two years, now becomes district manager at that point. A stock of Sullivan compressors, rock drills and duplicate parts and supplies is carried at the company's warehouse at Joplin. The new office is in the Keystone Hotel Block, corner of Fourth and Virginia Avenues.

When an engine, air compressor or other similar machine is worked beyond its capacity, it ceases to be an economical machine, as it costs more, for the work accomplished, than it would if a machine of proper size were employed. The use of a machine much too large for the work to be done is equally bad, as it is expensive to operate and the wear and tear amount to proportionately more than where the machine is suited to the work. For this reason it is inadvisable to install a large and expensive hoisting plant to sink the first 1000 feet of a deep shaft. A smaller machine of proper size is more economical in cost, operating expense and power required, and the larger engines, to be put in place later, are not worn out before they enter upon a period of activity for which they were designed.—*Mining and Scientific Press.*

Work on the railroad tunnel which is to be constructed under the Detroit River between Windsor and Detroit was commenced on August 25, when a force of men were set to work sinking the shaft on the American side. A similar shaft will soon be sunk on the Canadian side. While there is still much preliminary surveying and testing to be done, the location of the tunnel is practically decided upon. The maps of the engineers in charge of the construction show that the approach on the Detroit side will start midway between Fifteenth and Sixteenth streets on the present right of way of the Michigan Central Railroad. The actual length of the underground portion of the tunnel will be two and six-tenths miles, and the distance from surface to surface about three miles. It is estimated that between two and three years will be occupied in the construction.

Dr. W. B. Trimble has discovered a new treatment for lupus naevi (discolorations of the skin), especially of the hairy-mole variety. His remedy is liquid air. In the cases he has treated either cure or great improvement invariably followed the application of the liquid air. The fluid was applied by means of a pine or orange-wood stick with a piece of absorbent cotton twisted around the end, and the effect produced depends largely on the degree of pressure exerted in making the application. Light pressure causes a slight reaction and inflammation, all that is needed in some instances. Medium pressure will cause a superficial slough; this medium pressure is the kind called for in the hairy mole. Hard pressure will cause a deep slough. A certain amount of scarring has followed in most cases, but the beautifying effect has been far superior to the original lesion, and by careful application it may be reduced to a minimum. The liquid, according to the *British Medical Journal*, acts as a local anaesthetic, and the only sensation produced is one of slight tingling or burning. —*Science Siftings (Eng.).*

An ingenious respiratory apparatus for the use of firemen has been invented by Mr. Charles E. Chapin, a mechanical draftsman who lives in Berkeley, Cal. It consists of a hood lined with oiled silk to cover the head and an air cylinder which is strapped on the back. The cylinder is divided into three chambers, carrying under a pressure that can be regulated enough air to last an hour. The air is conducted by a rubber tube to the headpiece, the exhaled air passing out through a valve before the mouth. The fireman can get enough air to fill his lungs comfortably but cannot expend the supply in a short time, as he might be tempted to do if he became frightened. The main supply of air comes from the outer cylinders, the middle one being smaller and to be drawn upon only after the other two are exhausted. The apparatus can be adjusted on the back in half a minute, and, as it weights only 23 pounds, it does not impede the fireman in his work.

A test of the apparatus has been made

in the presence of the fire chief of San Francisco. A man equipped with the apparatus entered a room filled with the fumes of burning sulphur and worked there for a full hour, coming out with his throat and lungs perfectly free. The fire commissioners of San Francisco will have a practical demonstration of the apparatus, which is simple and not likely to get out of order. If on further test it proves satisfactory, it will be adopted by the San Francisco fire department and, doubtless, by the fire commissioners of other cities and towns.—*Scientific American.*

A paper on "High Speed Electric Compressors for Colliery Work," was read by Mr. W. W. Reavell before a recent meeting of the South Wales Institute of Engineers, England.

Many attempts have been made, said the author, to drive the ordinary form of air compressor for an electric motor by belts or gearing, but it is undoubtedly better to directly connect the motor and compressor together without the intervention of gears or any other speed-reducing medium. To attain this object the compressor should be specially designed, and the requirements for direct coupling to an electric motor are (1) that it should be single acting, with parts arranged to work in constant thrust; (2) that it should be accurately balanced; (3) that it should have as even a turning movement as possible; and (4) that it should be extremely compact. The author points out the difficulty of introducing electricity at the working face in mines, and the losses attendant upon the use of surface steam-driven air compressors. These losses may be saved by the use of electrical driving, and the method recommended is that the electrically driven compressor be either installed "in bye" or at the foot of the shaft. It may be urged that when steam is available on the surface for other purposes it is more economical to drive a large surface-air compressor direct rather than to produce electrical energy; but the author claims that the electrically-driven "in bye" compressor has the advantage in regard to economy, when losses due to leakage and friction with surface-air compressors are taken into account. The author estimates that out of 100 per cent. of energy applied in the steam cylinders no more than 40 per cent. is available at the working face, whereas in the electrically-driven system the proportion of original energy so available is 64 per cent. There is also the added advantage, if comparison is further extended, of the improved economy of the high-speed engine or steam turbine driving the generator.

A satisfactory device for discharging mails from high-speed trains, for which Post-office officials have been searching for more than seven years, has at last been discovered and following repeated tests, is now in daily use on one of the Rock Island's fast mail trains in Iowa.

Captain E. L. West, superintendent of the railway mail service, Chicago, and other Post-office officials who have witnessed the workings of the new device, are enthusiastic over the results accomplished. Equally good performance is shown on trains running at from fifteen to as high as seventy-two miles per hour.

The operation of the mail crane for picking up mails is familiar but the problem of discharging mails safely from the same trains, without hazard to the mails, trains and bystanders, has been a difficult one. A special commission appointed by the Postmaster General, in 1902, to examine the various devices offered the department, made thorough tests of eighteen different devices and reported, in May, 1903, rejecting all of them as having one or more points of impracticability. The Commission consisted of E. J. Ryan, superintendent Railway Mail Service, Boston; B. J. Bradley, superintendent Railway Mail Service, New York; O. T. Hollaway, superintendent Railway Mail Service, Cincinnati; Capt. E. L. West, superintendent Railway Mail Service, Chicago; S. M. Gaines, superintendent Railway Mail Service, Fort Worth; Thos. P. Graham, superintendent Mail Equipment, Washington, D. C.; J. H. Crew, general superintendent Railway Adjustment, Washington, D. C.

The Burr delivering device was among those examined, but the objections entered against it have been overcome. The device is entirely automatic and is operated by air from the brakes of the train and the instantaneous action necessary, is thus secured.

The device consists of a platform arranged in the car door, on which the sacks of mail to be delivered are placed. Contact between the crane on the station platform and a trigger on the mail-catch-

ing arm on the car, puts the mechanism in operation, which ejects the mail sacks into a receiving box placed at the side of the track, so constructed that the air is forced into either end by the momentum of the pouch and thus acts as a cushion, preventing damage to the pouch or its contents. The Burr device, combined with the standard crane, can be operated either to catch or deliver mail.

The two tunnels of the New York and Long Island Railroad under East River, between New York and Long Island City bring the total number of subaqueous tunnels entering Manhattan Island up to fourteen. The new railroad will connect with the present New York subway system at Third avenue and Forty-second street, at which point a large subterranean station will be built about 80 feet below the Subway grade. Esculators will carry passengers from Long Island to the Subway station and the surface. At the eastern terminus, connection will be made with surface lines on Long Island.

The Degnon Contracting Company is the contractor for the new tunnels and has just placed one of the largest machinery orders of recent times with the Ingersoll-Sergeant Drill Company, of New York.

This order includes fourteen air compressors, of two different types. Eight are of duplex compound Class "HC" pattern with steam cylinders 16 and 28 inches in diameter, air cylinders 25¼ and 16¼ inches in diameter, and a stroke of 16 inches. Each unit has a free air capacity of 1205 cubic feet per minute. The other six are of straight-line Class "A" type, with a 24-inch steam cylinder, 26¼-inch air cylinder and a stroke of 30 inches. The capacity of each is 1444 cubic feet per minute. The aggregate free air capacity of the fourteen compressors is 18,304 cubic feet per minute.

The shield method will be used in driving these tunnels. The straight line compressors will furnish air to the headings for keeping out the water, and will also supply intake air to the other machines. The compound units, drawing their air at discharge pressure of the low pressure machines, will furnish air at high pressure to the rock drills and other machinery in the tunnel bores.

As at present planned, the work of driving these tunnels contemplates three shafts. One will be at the Long Island terminus; another at Forty-second street and the river front in New York. The third will be on Man-o-war's Reef in East River and some interesting work will be done here in providing room for a power plant. Ultimately it is expected that quite a large island will be made here with the rock removed from the tunnel. From this central shaft, the bores will be driven in both directions. The fourteen compressors will be distributed among the three plants.

This last order makes a total of 54 Ingersoll-Sergeant air compressors in use or contracted for on subaqueous tunnels entering New York City. The aggregate free air capacity of these machines is 138,426 cubic feet per minute, and the pressures delivered range 30 to 150 pounds. This company has furnished all the compressors for this class of work in New York and vicinity.

The ammonia compressor used in connection with refrigerating plant is usually run at a comparatively low speed on account of the peculiar difficulties met with in the work it has to perform. As in the case of all machinery for compressing gas, it is essential to the attainment of even moderate economy that the clearance spaces in the compressor cylinder should be as small as practicable; but while, in compressors for air or other so-called permanent gas, clearances may be reduced to the utmost limit allowed by mechanical considerations, a gas which liquefies under pressure complicates the problem. A liquid in the compressor cylinder cannot escape through the ordinary delivery valves as freely as gas, and being practically incompressible, is struck a blow by the advancing piston which is liable to break the cylinder-cover, or do other equally serious damage. The fracture of the cylinder of an ammonia compressor is, of course, a highly dangerous accident, on account of the nature of the escaping gas, and the provision of relief-valves, similar to those fitted to steam-engine cylinders, is not generally practicable, for the same reason. Consequently, it has been the custom to run ammonia compressors with a low piston speed, and reduce the chances of accident at the expense of providing large and volumetrically inefficient machines.

With the object of increasing the speed

at which ammonia compressors may be run with safety, Messrs. L. Sterne and Co., Limited, of the Crown Iron Works, Glasgow, have designed a type of machine embodying several important improvements. The most interesting feature of the new machines is the arrangement of the compressor cylinder. The piston is long and tubular, and has two lugs on each side at the centre of its length, to which the two piston-rods are attached. These lugs work in the suction chamber which surrounds the centre of the piston. The return gas enters the suction chamber and gets into the interior of the piston through large openings in its sides. Thence it passes alternately into the two compression chambers through light metallic plate valves on the ends of the piston. The end of each compression chamber is fitted with a delivery-valve of a similar type. The seating of the delivery-valves, which constitutes the end of the compression chamber, is, however, not solid with the walls of the chamber, but is held in place by a strong spring. This arrangement allows the piston to come almost in contact with the ends of the cylinder at every stroke with absolute safety; for even should it strike the end, no harm can be done. Also, if liquid ammonia should be present, there will be no shock when the piston strikes it, for it will cause the cylinder end to recede sufficiently for the liquid to escape round the edges of the seating of the delivery valve. Hence the clearances may be kept down to almost nothing, and the compressor run at a speed much higher than usual, with no fear of accident.

Another feature in the design, worthy of notice, is that, as the piston-rods are arranged to work outside the compressor chambers, they are not subjected to the variations of temperature during each stroke which their presence within the chamber would involve. The rods and the piston are kept at a moderately low and almost uniform temperature by being surrounded by the return gas, and as the piston-rod glands have only to withstand the suction pressure, they may be lightly packed, and the wear and tear due to the usual tight packings avoided.

These compressors are built by the makers in various sizes, ranging from 1 to 200 tons refrigerating capacity. The smaller sizes are vertical and single-acting.—*Engineering.*

One of the important recent developments in mining appears to be the introduction of the hand-hammer drills, which have now been in more or less use for about two years. Their employment has not yet become general, however, and it is still too early to determine just what their result in practice will prove to be. In all probability this will not remain long in doubt, inasmuch as the demand for a machine which will do what these are designed to do is so urgent that they will quickly receive trials under all the various conditions to be met in practice. Their field is, in brief, the use in narrow veins and in places difficult of access, wherein the large machine drills are at such disadvantage, for several reasons, that hand drilling has remained the cheaper method, notwithstanding the effort to meet the conditions by the one-man, or baby drill.

The hammer drill is a development of the familiar pneumatic riveting hammer that has been for a long time in successful use in machine-shop practice. From this was evolved the plug drill, which has found extensive employment for the drilling of small shallow holes for plug and feather work in quarrying, block-holing of boulders, large rocks, etc. Its employment in mining heretofore has been chiefly for such purposes. The new drills of this type which are now attracting attention, however, are designed for regular mining work, and it is to that application that interest is now chiefly directed.

The new drills are of light weight (only 15 to 20 pounds), and of simple construction. The working parts are few and easily kept in order. These are the chief factors in the usefulness of the machine. Incidentally the "helper" is dispensed with. The air consumption is comparatively large (approximately 20 cubic feet per minute), and the maximum depth of hole is only about 3 feet. In drilling holes of 2 feet depth in a fairly hard quartz the speed was a little more than 1 inch per minute. Considering that no time is lost in changing position, the hand-hammer drills are found to compare favorably with the work of a 2¼-inch machine drill on short holes.

The chief objection to the hand-hammer drills so far appears to be their inadaptability to all classes of rock, the latter presenting difficulties when either very dry or

very wet and soft. These difficulties are both connected with the hole, extending longitudinally through the bit, through which the air is exhausted. In dry rock the dust blown out of the hole becomes such a nuisance as to preclude the use of this type of drill, in some cases at least. On the other hand, in certain damp, soft ground the hole in the bit becomes clogged so tightly after a few minutes of work that further operation is impossible; the only way to clean the bit in this contingency is to send it to the shop and have the dirt drilled out. This appears to be a more serious difficulty than the dust trouble, inasmuch as the latter can be minimized by the provision of a suitable dust catcher, and possibly may be overcome entirely by the application of some form of water feed.

There are other kinds of ground in which these drills have certainly given very successful results. They would appear to be at their best in compact, fine-grained, moderately hard rock; and especially in dry rock of that character if the dust difficulty can be obviated, when the use of this type of drill would be nearly ideal. At all events, the hand-hammer drill has doubtless come to stay. If for nothing else, it will be a valuable adjunct to the mining equipment for block-holing and breaking boulders, cutting hitches in walls, and squaring up development work. In many cases, if not in all, it will be useful in drifting and stoping, and in some cases it will afford considerable economy, as, in fact, it has already done. Experience has yet to show, however, to what extent it will prove an "all-around" tool, what are its limitations and in what ways they may be overcome.—*Engineering and Mining Journal.*

The value of the air compressor for oil-raising purposes is gradually being proved in the various oil fields, and though its applicability is questioned in certain quarters, there can be no gainsaying the fact that its use is now upon almost every hand being extended. The air compressor has had stubborn foes from the time when the first experiments were carried out, yet in spite of the attacks to which it is still subjected by those who have all to lose by its general adoption, the reports which we, from time to time, receive as to its general work, tend to show that it has proved an efficient appliance where the product to be raised is not of too high a specific gravity. Those who advocate its adoption are not slow to put forward the argument that the yield of a well is considerably increased by the use of an air compressor in the place of the ordinary pump, and recent evidence to bear out this view does not appear to be lacking. In fact, we have it upon the authority of one of the most prominent company managers in America that such a statement can be substantiated up to the hilt, and that if only the air compressor were more widely used, the difference in dividends to the stockholders of the many operating oil companies would be great indeed.

In America, the air compressor cannot be considered a new apparatus for oil raising, for in the Kern River field of California it has enjoyed many years of use, and has fulfilled all expectations, while lately it has been adopted with much success in many of the Texas oil districts. Sour Lake and Saratoga have been foremost in its use, and the results achieved certainly go a long way to recommend the more general adoption of compressed air for oil raising, for, at the present time, the latest well of the Texas Co. is producing nearly 5,000 barrels of oil per day, while two other wells are yielding more than 3,000 barrels daily with the use of compressed air.

In regard to the work which has been carried out with the air compressor in the Kern River field, this may be summed up as having been entirely satisfactory; in fact, so much so that the companies which were responsible for making the first installations have, in almost every instance, greatly increased their plant. In the case of one company, an American contemporary points out that now, instead of being constantly troubled with the wearing out of machinery and consequent delays, the company has been able to remove all the oil from the wells, together with whatever sand was carried, while large pebbles have floated to the surface, assuring a free hole in the future, and giving promise that the vexatious stoppages of the past will not be experienced again. In 12 hours the air forces out all the oil, and the well is then allowed to rest for a similar length of time, after which pumping is resumed. In this way

a small compressor is able to do the necessary work for two wells.

In the Russian fields, the compressor is steadily extending its sphere of use, and today its advantages are admitted by many of the large producing firms where installations have been made. That the air compressor has some disadvantages must be admitted by the most unbiased mind, but these are gradually being overcome. One has been the liability to drop the level of the oil too suddenly and thus cause possibly a temporary stop in operations, but with wider knowledge of the compressor, and what it can and cannot do, the raising of oil by its means is bound to be largely carried out in the future. Year by year deeper drilling in the oil-producing districts of Russia is a necessity, and, consequently, with the constant reduction which must necessarily take place in the size of the borehole, the air compressor is bound to step in to far greater extent than it has done thus far. But, at the present time, we find that it is giving a most satisfactory account of itself where it has been properly used, and today quite a large number of the companies in the Baku district are successfully pumping simultaneously from two levels by its use. As time goes on, the air compressor as an expeditious and almost noiseless method of raising oil will perhaps be more appreciated, but thus far it has more than fulfilled expectations. —*The Petroleum Review.*

INDEX.

U. S. PATENTS GRANTED AUG., 1905.

Specially prepared for COMPRESSED AIR.

795,809. PNEUMATIC CONVEYOR. Arthur W. Banister, Boston, Mass. Filed Mar. 13, 1905. Serial No. 249,728.

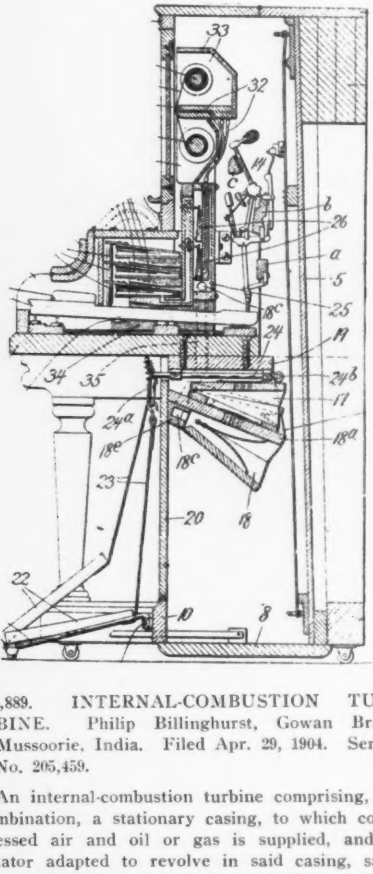
A force-blower, a conduit connected thereto, a feeding-in device interposed between the blower and the conduit, said feeding-in device comprising a receiving-chamber having an open unobstructed mouth, an inlet-nozzle leading into said chamber, an outlet-nozzle leading therefrom, and an inclined deflector-plate situated over the end of the inlet-nozzle and arranged to deflect the material into the outlet-nozzle, the front end 12 of said chamber inclining forwardly and downwardly from the front side of the mouth, thereby forming with the deflector-plate an inclined passageway leading to the outlet-nozzle.

796,094. PNEUMATIC-DESPATCH-TUBE APPARATUS. John F. Skirrow, East Orange, N. J. Filed Aug. 24, 1904. Renewed May 9, 1905. Serial No. 259,626.

796,165. DRILL-HOLE-ENLARGING DEVICE. Thomas M. Topp, Raymond, Cal. Filed May 1, 1905. Serial No. 258,352.

A device for enlarging and chambering drill-holes, said device including shanks having outwardly-turned bits at one end, segmental heads at the opposite end about which they are turnable, said heads having divergent adjacent faces and an interlocking point and socket substantially central of the curvature of the heads, a shank having a transversely-disposed segmental channel within which said heads fit and are turnable, and a fixed wedge-shaped block whereby the bits are forcibly separated at each stroke or impulse.

795,817. AUTOMATIC PIANO. Melville Clark, Chicago, Ill. Filed Feb. 6, 1905. Serial No. 244,326.



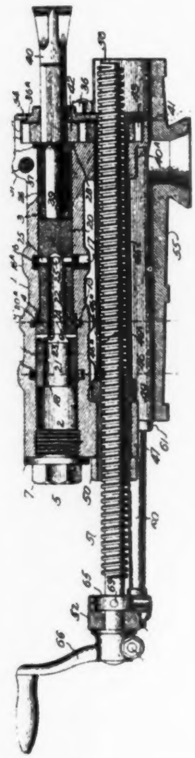
795,889. INTERNAL-COMBUSTION TURBINE. Philip Billinghurst, Gowan Brae, Mussoorie, India. Filed Apr. 29, 1904. Serial No. 205,459.

An internal-combustion turbine comprising, in combination, a stationary casing, to which compressed air and oil or gas is supplied, and a rotator adapted to revolve in said casing, said rotator consisting of cylindrical shells, a helical web fitted in said shells and star-shaped vans attached to said shells within the helical space formed by said web, substantially as described.

795,929. HYDRAULIC APPARATUS FOR RAISING OR FORCING LIQUIDS OR FOR COMPRESSING GASES. Howard D. Pearsall, London, England. Filed Sept. 8, 1904. Serial No. 223,767.

The combination of the main valve, a pendulum periodically operating the main valve independently of the flow of water in the supply-pipe, and means for keeping the pendulum in motion.

796,081. DRILL-BIT-ROTATING MECHANISM FOR ROCK-DRILLING ENGINES. John G. Leyner, Denver, Colo. Filed June 24, 1904. Serial No. 213,988.



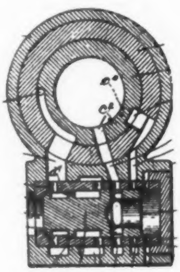
A rock-drill, comprising a cylinder having a piston-hammer and a revoluble drill-chuck, a support on which said cylinder is slidably mounted, a feed-screw in engagement with said cylinder and support, and means whereby rotation of said screw effects rotation of said chuck, as set forth.

In a rock-drilling engine, a cylinder, a supporting-shell in which said cylinder is slidably mounted, a piston-hammer reciprocally mounted in said cylinder, a drill-bit supported in said cylinder in the reciprocal path of said piston-hammer, a gear rotatably mounted in said cylinder and provided with a polygonal-shaped axial aperture, surrounding the entrance to said drill-bit, a polygonal-shaped surface on said drill-bit adapted to register loosely in the aperture in said gear, a second gear rotatably journaled in said cylinder and arranged in operative mesh with

said drill-bit's gear; a sleeve projecting from said gear, a feed-screw operatively connected to said cylinder and shell extending through said sleeve, and means connected with said feed-screw and said sleeve whereby rotation of said feed-screw effects rotation of said drill-bit.

796,207. PNEUMATIC COTTON-HARVESTER. William F. Harbour, Atlanta, Ga. Filed Apr. 6, 1905. Serial No. 254,162.

796,217. FLUID - PRESSURE - OPERATED TOOL. Charles H. Johnson, Chicago Heights, Ill. Filed Aug. 5, 1902. Renewed June 24, 1905. Serial No. 266,848.



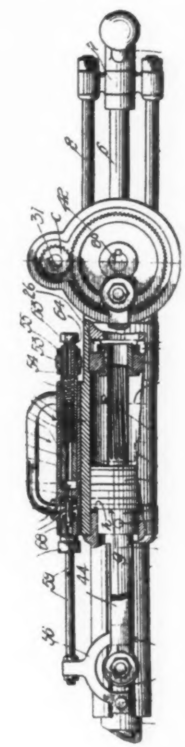
A fluid-pressure-operated tool the combination with a cylinder, of a reciprocating piston therein, a valve-casing having an open end communicating with the atmosphere and having ports communicating with the opposite ends of the cylinder, a differential piston-valve located in said casing controlling the supply and exhaust of fluid-pressure, said cylinder and valve-casing having ports and passages whereby said valve is retained in position to admit fluid-pressure to one end of the cylinder by the pressure of the fluid exhausting from the other end of the cylinder.

796,263. CARRIER FOR PNEUMATIC-DESPATCH TUBE APPARATUS. Charles F. Stoddard, Boston, Mass., assignor to American Pneumatic Service Company, Dover, Del., a corporation of Delaware. Filed May 20, 1904. Serial No. 208,813.

796,327. ATTACHMENT FOR ROCK-DRILLS. Martin Hardsocg, Ottumwa, Iowa. Filed June 3, 1904. Serial No. 210,964.

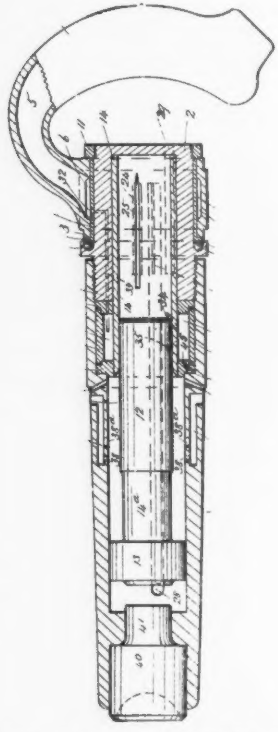
Combination with a bit, a protective sheath having walls of flexible material adapted to be expanded by the forward movement of the bit and having a mouth adapted to abut against the substance being acted on and provided with an opening having walls adapted to impinge against the shank of the bit, and an exhaust-pipe for exhausting air from the interior of the sheath, substantially as described.

796,228. ROCK-DRILL. Edwin R. Langford, Los Angeles, Cal., assignor of one-half to Jessie C. Hewitt, Los Angeles, Cal. Filed Dec. 7, 1903. Serial No. 184,140.



A cylinder, a piston therein, a piston-rod connected thereto, a pitman, means for connecting the pitman with the piston-rod, a head connected to the rear of the cylinder, the upper portion of which is cupped and a portion of the head being formed in a journal, a shaft in the journal, a gear on the shaft, said gear lying within the cupped portion, a crank connecting the pitman and gear, another journal formed in the head, a driving-shaft mounted in the journal, a pinion on the driving-shaft within the cupped portion of the head and meshing with the gear.

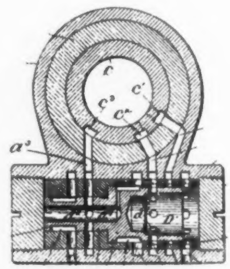
796,350. PERCUSSIVE HAND-TOOL. Henry Potter, Bromley, England. Original application filed Dec. 17, 1904. Serial No. 237,307. Divided and this application filed Feb. 23, 1905. Serial No. 246,911.



An impact-tool, the combination, with two cylinders of different area, of a piston provided with two heads slidable in the two said cylinders, a slidable tool arranged in the path of the said piston, and a cylindrical valve journaled in the smaller of the two said cylinders which admits a charge of pressure fluid to the rear end of the said smaller cylinder to propel the piston forward and which subsequently admits the said charge to the front end of the larger cylinder to return the piston, the rear part of the said larger cylinder being provided with an open air-port.

796,506. FLUID-PRESSURE MECHANISM. Clyde C. Farmer, Chicago, Ill., assignor to The Westinghouse Air Brake Company, Pittsburg, Pa., a corporation of Pennsylvania. Filed Jan. 6, 1902. Serial No. 88,568.

796,374. FLUID-PRESSURE-OPERATED TOOL. Henry H. Vaughan, Cleveland, Ohio, assignor to Ridgely and Johnson Tool Company, a corporation of Illinois. Filed Nov. 19, 1902. Renewed June 24, 1905. Serial No. 266,850.



A fluid-pressure-operated tool, the combination with a cylinder, of a reciprocating piston therein, a valve-casing having ports communicating with the opposite ends of the cylinder, a differential piston-valve located in said casing controlling the supply and exhaust of fluid-pressure, said cylinder and valve-casing having ports and passages whereby said valve is retained in position to admit fluid-pressure to one end of the cylinder by the pressure of the fluid exhausting from the other end of the cylinder.

796,395. ELASTIC-FLUID MOTOR. Peter B. Belches, Haymarket, Va. Filed Jan. 13, 1905. Serial No. 240,945.

An elastic-fluid motor embodying a vaned wheel, a nozzle for directing the elastic fluid against the vanes, a rotary cut-off rotated by the rotation of the wheel and operating to periodically cut off the flow of fluid to the nozzle and means for varying the duration of the cut-off period.

796,449. AIR-PUMP FOR AUTOMOBILES. Samuel N. Rapp, Detroit, Mich., assignor of one-half to Alvin S. Clark, Detroit, Mich. Filed Aug. 10, 1903. Serial No. 168,853.

796,703. SHEET-PILE-DRIVER. Amasa B. Clark, New York, N. Y. Filed June 10, 1902. Serial No. 110,988.

A portable pile-driver comprising a direct-acting reciprocating engine, a rigid supporting-shank secured thereto and means rigidly connected to the free end of said rigid shank for receiving the end of a pile.

796,375. FLUID-PRESSURE-OPERATED TOOL. Henry H. Vaughan, Cleveland, Ohio, assignor to Ridgely and Johnson Tool Company, a corporation of Illinois. Filed Nov. 19, 1902. Renewed June 24, 1905. Serial No. 266,851.

A fluid-pressure-operated tool, the combination with a cylinder, of a reciprocating piston therein, a valve-casing having separate ports for the admission and exhaust of motive fluid to one end of the cylinder, a piston-valve located in said casing, controlling the supply and exhaust of fluid-pressure, said cylinder and valve-casing having ports and passages whereby said valve is retained in position to close the admission-port to one end of the cylinder by the pressure of fluid passing through the exhaust-port from the same end of the cylinder.

796,706. PNEUMATIC MOTOR FOR CONTROLLING-SHEETS OF MUSICAL INSTRUMENTS. Melville Clark, Chicago, Ill. Filed Nov. 12, 1902. Renewed Apr. 24, 1905. Serial No. 257,096.

796,996. SPRAYING APPARATUS. Clinton Gibson, Allegan, Mich. Filed Sept. 21, 1903. Serial No. 173,925.

An apparatus of the class described, the combination of a pump-cylinder, a piston and piston-rod, valved inlet-pipes connected to the opposite ends of said cylinder, a supply-pipe connected to these inlets, valved outlets arranged at the opposite side of said cylinder at its opposite ends, a pipe 9 connecting these two outlets, a spray-hose connected to one end of said pipe 9 and provided with a stop-cock, a pressure-tank, and a pipe connecting the opposite end of said connection 9 with the bottom of said tank, as and for the purposes set forth.

796,959. FLUID-PRESSURE REGULATOR. William T. Croslen, Oak Park, Ill., assignor to Frank H. Earle, trustee, Plano, Ill. Filed Sept. 12, 1904. Serial No. 224,199.

796,985. FLUID-PRESSURE-VALVE-LUBRICATING MECHANISM. Thomas R. Brown, Wemple, N. Y. Filed Feb. 29, 1904. Serial No. 195,704.

797,044. CARRIER FOR PNEUMATIC-SERVICE SYSTEMS. Harry Burl, London, England, assignor to Lamson Consolidated Store Service Company, Boston, Mass., a corporation of New Jersey. Filed Jan. 4, 1904. Serial No. 187,624.

797,053. PNEUMATIC-DESPATCH-TUBE APPARATUS. Edmond A. Fordyce, Boston, Mass., assignor, by mesne assignments, to Lamson Consolidated Store Service Company, Newark, N. J., a corporation of New Jersey. Filed May 31, 1904. Serial No. 210,331.

797,138. FABRIC FOR PNEUMATIC TIRES. Charles L. Marshall, Newark, N. J. Filed Oct. 22, 1904. Serial No. 229,589.

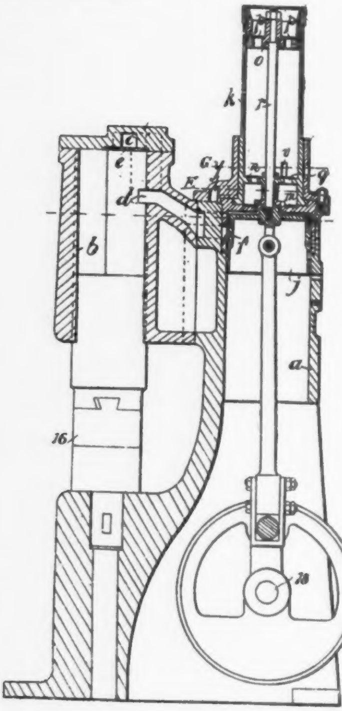
797,162. PRESSURE-REGULATING DEVICE. Henry H. Westinghouse, Edgewood, and Francis L. Clark, Pittsburg, Pa., assignors to The Westinghouse Air Brake Company, Pittsburg, Pa., a corporation of Pennsylvania. Filed Nov. 9, 1899. Serial No. 736,422.

797,200. PNEUMATIC TIRE. Jackson O. Haas, Pottsville, Pa. Filed Aug. 1, 1903. Serial No. 167,914.

797,241. PNEUMATIC RENOVATOR. John S. Thurman, St. Louis, Mo. Filed Mar. 24, 1904. Serial No. 199,760.

A pneumatic renovator, the combination with a casing, of a blast-nozzle, a removable dust-chamber carried by said casing and provided with an opening in its bottom for the dust-laden air from said casing, and means for preventing the return of the dust-laden air from said dust-chamber to said casing.

797,055. POWER-HAMMER. William Graham, Westminster, England. Filed June 16, 1904. Serial No. 212,867.



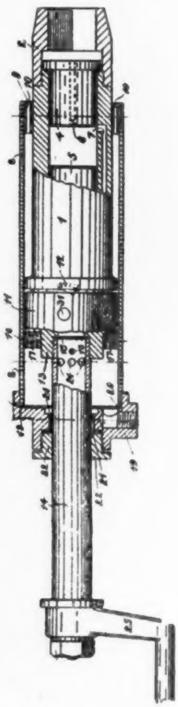
A pneumatic hammer, comprising a hammer tup and chamber; a pump arranged to produce alternate suction and compression and connected to the tup chamber through short passages; a second pump adapted to produce vacuum only and in communication with the first-mentioned pump through a controlled passage, and means for controlling said passage, substantially as and for the purposes described.

797,182. TONE-EXPRESSION-CONTROLLING DEVICE FOR MECHANICAL MUSICAL INSTRUMENTS. Thomas Danquard, New York, N. Y., assignor to The Autopiano Company, New York, N. Y., a corporation of New York. Filed Mar. 3, 1905. Serial No. 248,243.

797,265. AIR-BRAKE SYSTEM. George E. Congdon, Syracuse, N. Y. Filed Sept. 13, 1904. Serial No. 224,279.

797,315. AIR-BRUSH. Jens A. Paasche, Chicago, Ill., assignor of one-half to Olof G. Paasche, Elgin, Ill. Filed Jan. 27, 1905. Serial No. 242,926.

797,111. ROCK-DRILL OR ROCK-DRILLING MACHINE. Henry Hellman and Lewis C. Bayles, Johannesburg, Transvaal. Filed Nov. 23, 1904. Serial No. 233,934.



A rock-drilling machine or engine, in combination, a power-cylinder carrying the percussive apparatus and the drilling-bit or boring-tool, a casing surrounding said cylinder, a packing located at the rear of the cylinder forming an air-tight joint with the interior of the casing, a pipe attached to the rear end of the cylinder formed with holes placing the casing in communication with the interior of the cylinder, a cover fitted on the rear end of the casing formed with an inlet through which the actuating fluid enters the casing, said cover serving as a guide or support for the pipe, and means for rotating the power-cylinder and bit or tool, substantially as described.

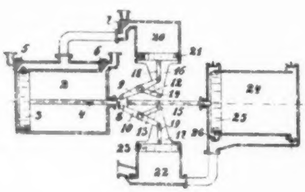
797,398. ELECTROFLUID - PRESSURE SWITCHING MECHANISM. Walter J. Bell, Los Angeles, Cal., assignor of one-half to Leon F. Moss, Los Angeles, Cal. Filed Aug. 25, 1904. Serial No. 222,175.

797,336. AIR-BRAKE. Edwin B. Temple, Boston, Mass. Filed Oct. 29, 1904. Serial No. 230,516.

797,361. APPARATUS FOR MIXING AIR AND GAS FOR ILLUMINATING PURPOSES. Heinrich L. Karger, Berlin, Germany, assignor to Selas Gesellschaft mit Beschränkter Haftung, Berlin, Germany. Filed July 7, 1903. Serial No. 164,538.

An apparatus of the character described, the combination of a circulation-conduit, means for inducing circulation therein, a pressure-valve connected with said circulation-conduit and controllable by pressure therefrom, an air-inlet and a gas-inlet connected with said circulation-conduit, and means actuated by air-pressure, controlled by said pressure-valve for cutting off the supply of gas and the supply of air.

797,417. AIR-COMPRESSOR. Wilhelm Engelking, Aachen, Germany. Filed Aug. 30, 1902. Serial No. 121,664.



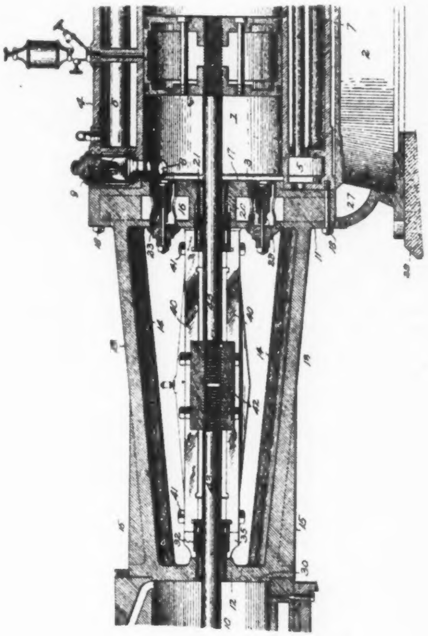
The combination of a low-pressure air-cylinder, a motor steam-cylinder in line therewith, a piston in each cylinder, a piston-rod connecting the pistons in the low-pressure air-cylinder and the steam-cylinder, a high-pressure air-compressor cylinder at right angles to first-named cylinders, piston and piston-rod therefor, a connecting-tube between the high-pressure and low-pressure air-cylinders, a lever pivotally connected at its opposite ends to the piston-rod in the low-pressure cylinders and to the right-angle piston-rod, a link pivoted at one end to the middle of said lever and at the other end to a fixed pivot.

797,440. PRESSURE-CONTROLLING DEVICE. William F. Krichbaum, Newark, N. J., assignor of one-half to D. Lewis Dalrymple, Newark, N. J. Filed Apr. 3, 1905. Serial No. 253,704.

797,524. SUBAQUEOUS TUNNEL. Duncan D. McBean, New York, N. Y. Filed Nov. 27, 1903. Serial No. 182,707.

Subaqueous-tunnel construction, the method of vertically excavating progressively contiguous sections of the tunnel site, then laying foundations in the excavated spaces, and then completing the superstructure thereon, all under pneumatic pressure.

797,519. COMBINED FRONT-CYLINDER-HEAD AND CROSS-HEAD SUPPORTING FRAME FOR STEAM AND POWER AIR-COMPRESSORS. John G. Leyner, Denver, Colo. Original application filed Oct. 1, 1902. Serial No. 125,539. Divided and this application filed Sept. 2, 1903. Serial No. 171,626.



A device of the character described, consisting of an integral casting comprising a pair of suitably-constructed and oppositely-arranged cylinder-heads which are connected by brace-bars, holes through said cylinder-heads in axial alinement with each other, and lugs upon opposite sides of each cylinder-head, and guideways connecting the lugs on one cylinder-head, with those on the other cylinder-head, substantially as shown.

The combination with an air-compressing cylinder, the cylinder of an actuating-engine, and a piston-rod common to both cylinders which is provided centrally with a cross-head, of a distance-piece connecting the two cylinders, consisting of

an intregal casting comprising a pair of oppositely-arranged heads which are united by brace-bars, one of said heads being bolted to the cylinder of the actuating-engine, while the other head is bolted to the air-compressing cylinder, said latter head being formed with an interior annular air-space which communicates with the atmosphere, said air-space surrounding a central hub portion; a bore through said hub portion, a bore through the steam-cylinder head, said bores being in axial alinement, suitable stuffing-boxes in each bore through which the piston-rod passes; lugs on opposite sides of the heads, guideways extending from the lugs of one head to those of the other head in which the cross-head of the piston-rod travels; a circular series of holes through the walls of the air-cylinder head, concentric with its axial bore, and valves in said holes which control the communication between the air-space of said head and the interior of the air-compressing cylinder, substantially as shown.

797,525. SUBAQUEOUS TUNNEL. Duncan D. McBean, New York, N. Y. Filed Apr. 30, 1904. Serial No. 205,671.

The method of constructing subaqueous tunnels, which consists in first building a foundation or base, and then progressively erecting the tunnel superstructure thereon within a pneumatic chamber.

797,542. FLUID-PRESSURE BRAKE. Henry H. Westinghouse and Francis L. Clark, Pittsburg, Pa., assignors to The Westinghouse Air Brake Company, Pittsburg, Pa., a corporation of Pennsylvania. Original application filed Nov. 9, 1899, Serial No. 736,422. Divided and this application filed Dec. 15, 1903. Serial No. 185,283.

797,587. GAS-PRESSURE REGULATOR. Samuel H. Lanyon, Waukegan, Ill. Filed Mar. 6, 1905. Serial No. 248,487.

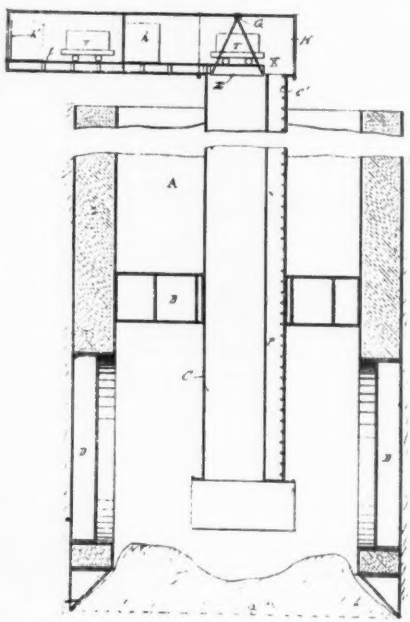
A device of the class described, the combination of a horizontally-disposed furnace, having a hearth extending longitudinally of the same; a conveyor extending along said hearth from end to end and carrying a succession of alternate sets of relatively fixed and rotating stirring devices, said fixed devices being adapted to enter the mass of material resting on the hearth and turn the same into logitudinal furrows, and said rotating devices having arms adapted to enter the mass of material and roll in a longitudinal direction.

797,664. AUTOMATIC GAS-PRESSURE REGULATOR AND CUT-OFF. John W. Cottingham and Charles W. Franklin, Leipsic, Ohio. Filed Mar. 16, 1905. Serial No. 250,390.

A pressure-regulator, in combination, a casing having an inlet and an outlet, a valve at the inlet, and a separate cut-off valve at the outlet, and pressure-operated controlling means for each of said valves located in the casing between the valves and both subject to the same pressure.

797,714. FLUID - PRESSURE - CONTROLLING VALVE. Robert W. Barton, Chicago, Ill., assignor to Barton Boiler Company, Chicago, Ill., a corporation of Illinois. Filed Apr. 3, 1905. Serial No. 253,559.

797,815. AIR-LOCK APPARATUS FOR CAISSONS AND TUNNELS. Ernest W. Moir, London, England, assignor to S. Pearson and Son, Incorporated, Long Island City, N. Y., a corporation of New York. Filed Mar. 18, 1905. Serial No. 250,780.



Air-lock apparatus for excavating-work, comprising a vertical shaft and a hoisting-cage therein on which a wheeled truck may be run with a

substantially horizontal air-lock, into and from which said truck may be run from and onto the cage.

797,766. GAS-PRESSURE-REGULATING DEVICE. Gustaf Dalen, Stockholm, Sweden, assignor, by mesne assignments, to Aktiebolaget Gasaccumulator, Stockholm, Sweden. Filed May 19, 1904. Serial No. 208,778.

797,796. HOSE OR PIPE COUPLING. Edward Devlin, San Francisco, Cal., assignor to John T. Scott, San Francisco, Cal. Filed Jan. 24, 1905. Serial No. 242,460.

A coupling for air, steam or water hose, the same comprising a lock and an interlocking member, a socket in the lock member for the reception of the inner end of the interlocking member, two bayonet-slots formed in the lock member, projecting studs on the interlocking member which work within the bayonet-slots when the interlocking member has been forced into and turned within the locking member, the locking member having a straight bearing portion, and said interlocking member having a peripheral groove near its inner end with oppositely-disposed inclined or beveled walls, and an elastic washer or ring movably seated within said peripheral groove, and adapted to be forced by the respectively inclined walls of the groove into wedging engagement with said straight bearing upon longitudinal movement of the interlocking member in either direction.

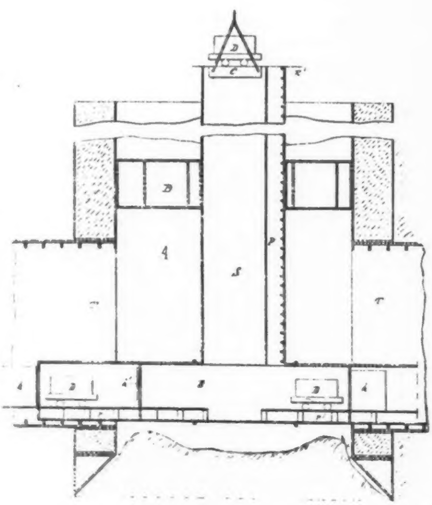
798,060. PNEUMATIC TRACK - SANDER. Henry Rau, Jr., Baltimore, Md. Filed Dec. 22, 1904. Serial No. 237,881.

798,137. AIR-BRAKE HOSE. Frank A. Magowan, Trenton, N. J. Filed May 16, 1905. Serial No. 260,635.

798,286. HOIST-BRAKE. Henry J. Kimman, Cleveland, Ohio, assignor to Chicago Pneumatic Tool Company, Chicago, Ill., a corporation of New Jersey. Filed Oct. 10, 1904. Serial No. 227,803.

The combination with a hoist operated by fluid-pressure, of a pressure-brake therefor, a supply-pipe for the motor of the hoist, a branch connection leading to the brake, an exhaust-pipe, a valve-chest containing three motor-ports, two of them terminal ports and the third an exhaust-port, a valve connecting the exhaust-port to the two terminal ports alternately, and means for admitting pressure to the brake when the said valve is in its intermediate position.

797,816. AIR-LOCK APPARATUS FOR TUNNELS. Ernest W. Moir, London, England, assignor to S. Pearson and Son, Incorporated, Long Island City, N. Y., a corporation of New York. Filed Mar. 18, 1905. Serial No. 250,78.



Air-lock apparatus for tunnels having a vertical shaft and hoisting-cage therein, adapted to receive a wheeled truck and a horizontal air-lock opening from the bottom of the shaft, such horizontal air-lock having runways for the truck.

798,321. TRAIN-PIPE COUPLING. Martin J. Carter, St. Louis, Mo. Filed Jan. 10, 1905. Serial No. 240,470.

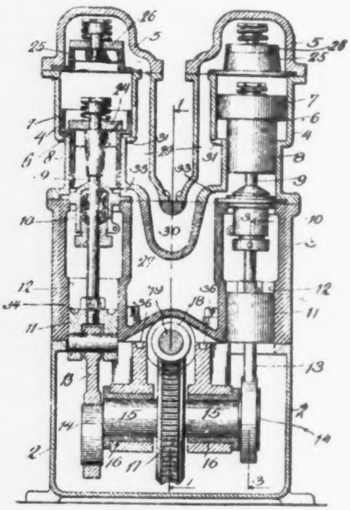
798,416. ROCK-DRILL. Manetho C. Jackson, Denver, Colo., assignor to The Jackson Electric Drill and Supply Company, Denver, Colo. Filed Feb. 15, 1904. Renewed Jan. 30, 1905. Serial No. 243,349.

A rock-drill or similar machine, the combination with a crank-shaft, of a hammer, a drill-bit arranged to be acted on by the hammer, and

suitable connections between the crank-shaft and the hammer and between the crank-shaft and drill-bit for simultaneously importing to the hammer and bit a reciprocating movement.

798,429. COMPRESSED-AIR BRAKE FOR RAILWAY-TRAINS. Charles Luyers, Vilvorde, Belgium. Original application filed Sept. 28, 1903, Serial No. 174,931. Divided and this application filed Dec. 17, 1904. Serial No. 237,196.

798,506. PUMP OR COMPRESSOR. Milan W. Hall, Brooklyn, N. Y. Filed Mar. 4, 1904. Serial No. 196,522.



A double-acting pump or compressor, the combination with a differential cylinder and a reciprocating piston having differential heads fitted thereto, and having a passage therethrough from one end to the other, of a suction-valve carried by the piston and controlling said passage, and a discharge-valve fitted to the cylinder, the cylinder at the rear of the larger piston-head being open freely to discharge.

798,508. PNEUMATIC-TIRE CAP. Henry Harmon, Chicago, Ill., assignor to The Harmon Manufacturing and Distributing Company, Chicago, Ill., a corporation of Illinois. Filed Oct. 10, 1904. Serial No. 227,770.

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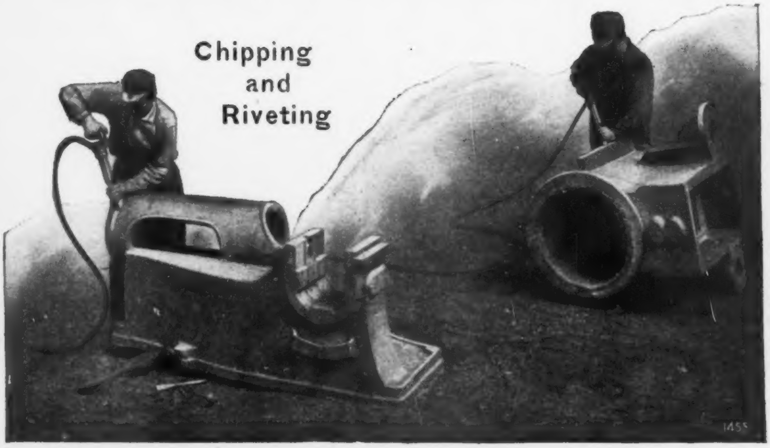

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